THE

AMERICAN NATURALIST

VOL. XXVI. May, 1892. 305

HISTORY OF THE MOAS.

By F. W. HUTTON.

The Moas belong to a group of birds called Ratitæ, to which also belong the Ostrich, the Rhea, the Emu, the Cassowary, and the Kiwi. They are all birds with rudimentary wings, soft fluffy feathers and adapted for terrestrial life. Professor T. J. Parker has conclusively proved that the Ratitæ are descended from flying birds. The structure of their diminutive wings and the cellular character of their bones are evidence that the ancestors of the Ratitæ could fly, but these flying ancestors must have lived a very long time ago, probably in the early part of the eocene period. That the Moas have been a long time in New Zealand is certain. In addition to the immense number of bones found in peat beds and river-alluvia of pleistocene age, remains have been found near Napier and probably also near Wanganui, which belong to the newer pliocene period. The bones of a small species of Moa, found two years ago under a lava stream at Timaru, are still older and probably upper miocene, while the Hon. W. Mantell found in 1849 a fragment of a bone, which probably belonged to a Moa, near Moeraki in beds of lower miocene age.

The Ratitæ are generally supposed to have originated in the Northern Hemisphere, and to have spread southwards into Patagonia, South Africa, Australia and New Zealand. But if so, how could birds which could not fly manage to reach New

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Zealand without being accompanied by any Mammalia? Certainly they did not precede the Mammalia, and it is very unlikely that they should twice have swum across straits which were impassable to mammals—once from the Oriental into the Australian region, and again from the Australian region into New Zealand—and there are other reasons for doubting the northern origin of the Australasian Ratitæ. The New Zealand Ratitæ are smaller than any of the others, and make a nearer approach to the original flying ancestors; and we should expect to find the smallest and least altered forms near the place of origin. Now there are in Central and South America a group of birds called Tinamous, which, although flying birds, have been shown by the late Professor W. K. Parker to resemble the Australasian Ratitæ in many particulars, and as the connection between South America and New Zealand is well known, it seems more probable that the Moas originated in New Zealand in the eocene period, from flying birds related to the Tinamous, and that they spread from here into Australia and New Guinea, than that they should have migrated southward from Asia.

In whatever way the Moas originated in New Zealand, it is evident that the land was a favorable one, for they multiplied enormously and spread from one end to the other. Not only was the number of individuals very large, but they belonged to no less than seven genera, containing twenty-five different species, a remarkable fact which is unparalleled in any other part of the world. Africa and Arabia are inhabited by but two or three species of ostrich; South America from Peru to Patagonia, has only three species of Rhea; Australia has two species of Emu and one Cassowary; while eight other species of Cassowary inhabit islands from New Britain to Ceram. Outside New Zealand two species of Ratitæ are rarely found living in the same district while a few hundred years ago there were in New Zealand several different kinds of Kiwi as well as the twenty-five species of Moas. An explanation of this problem may perhaps be found by examining the present distribution of the Cassowaries. Here we have eight species inhabiting five different islands, and if this region of the earth were to be

elevated, and the islands joined together, these eight species would mingle. If the region were to sink once more all of them would be driven to the highest land, and might all be crowded into one small island. Now we know, from geology, that New Zealand has gone through a series of changes in level, similar to those just mentioned. In the miocene period it consisted of a cluster of several islands, which were elevated and united in the older pliocene, and ultimately divided into the two islands we have now in the newer pliocene. If the ancestors of the Moas inhabited New Zealand during the eocene period they must have been separated on these islands during the whole of the miocene, and mingled together again in the pliocene. In this way—*i.e.*, by isolation—probably the genera originated, but the species appear to be due to variation without isolation. As is the case with most common animals, the Moas varied greatly and, there being no carnivorous mammals to hold them in check, while vegetable food was abundant, natural selection did not come into play, and the intermediate forms were not strictly eliminated. Under such favorable circumstances the conditions of life were easy, and the birds got larger and fatter, more sluggish and more stupid. The oldest known Moa is one of the smallest, and it is the smaller species which are found in both islands; from which we may infer that they were the only ones in existence when the two islands were united, and that the Moas since then increased in size. But the very large Moas were always comparatively rare. The commonest kinds in the North Islands were only from two and a half to four feet high, while those of the South Island were mostly from four to six feet in height. The giant forms, going up twelve and thirteen feet, were seldom seen.

Throughout the pliocene period the Moas flourished greatly; but in the pleistocene they must, in the South Island, have died in large numbers, for how else could such immense quantities of bones have come together in the peat-beds at Glenmark and at Hamilton in Central Otago. It has often been suggested that flocks of birds, attempting to escape from fires, rushed into the swamps and perished. But when we remember

that these Moas died thousand of years ago, long before there were any human inhabitants to light fires, it will be seen that this surmise is quite out of the question. Only two hypotheses appear to be possible to account for the facts. Either the birds walked into the swamp and were drowned or else their dead bodies were washed in. The first hypotheses is probably the explanation of the deposit at Te Aute near Napier, because many of the leg bones were found upright in their natural position. But at Glenmark and at Hamilton the bones were lying in all directions, as often upside down as in any other position, and the peat-beds were only a few feet thick, and filled with bones up to the very top. We cannot, therefore, suppose that these Moas were swamped, and there is evidence in both of these cases to show that the dead bodies of birds were washed in by floods. We find corroborative evidence of this in the alluvial plains of Central Otago, for these always contain numerous bones wherever a stream enters them from the hills.

But how are we to account for the number of dead birds washed down from the hills? There are two remarkable facts connected with these bone deposits at Hamilton and Glenmark. One is the very large proportion of bones of young birds from one-half to three-quarters grown; and the other is the absence of Moa egg shells. These two facts seem to show that the birds perished in the autumn or winter, when the birds of the year were not full grown, and when the females did not contain any hardened eggs. Also, it is evident that dead Moas could not be washed into swamps under the present climatic conditions, and the explanations of the puzzle must lie in the fact that in pleistocene times, when these bone deposits were formed, the climate was very different from what it is now. At that time the eccentricity of the earth's orbit was very great, and when winter in the Southern Hemisphere happened in aphelion, long cold winters were followed by short and very hot summers. It seems probable therefore, that the early winter snows killed large numbers of Moas and other birds on the hills, that their bodies were floated down by summer floods and avalanches caused by the melting snow,

and that they were deposited in hollows at the foot of the hills. As the pleistocene period passed away the climate became more equable and the surviving Moas once more increased and multiplied, until they were ultimately exterminated by the hand of man.

All are now agreed that the Moas were exterminated by the ancestors of the Maoris, and the only question upon which opinion is still divided is, How long ago was this? The case seems to me to stand thus. In the North Island there are several names of places in which the Moa is incorporated, but in the great number of Maori tales and poems which have been collected by Europeans the allusions to the bird are very slight and obscure, generally, indeed, fabulous. There is also one very ancient poem called " The Lament of Ikaherengatu. " in which the pharse " Ka ngaro i te ngaro a tea Moa " (lost as the Moa is lost) occurs, which certainly shows that the bird was not in existence when the poem was composed. The so-called traditions of its habits appear to be, in large part at least, late deductions from these words and phrases, and we must conconclude that in the North Island, the Moa was exterminated by the Maoris soon after their arrival in New Zealand; that is not less than 400 or 500 years ago.

In the South Island there are no names of places containing the word Moa, but here remains have been found—either skeletons lying on the surface or bones with skin and ligaments still attached—which give the impression that the birds were living here not more than ten or twelve years ago. Now the bones which are said to have strewn the surface so abundantly when the first settlers came, had all disappeared in fifteen years; so it is plain that either some change in the surrounding conditions cause the bones to decay, or that none of the bones which were so abundant in 1861, were more than fifteen years old. But as we cannot believe that Moas were abundant in Otago in 1846, we must fall back on the opinion that the fires lighted by the early settlers to clear the scrub so altered the conditions under which the bones had been preserved that they soon decayed, in which case we cannot say how long the bones may have been lying there. It is some-

thing the same with those bones which still have dried skin and ligaments attached. They are so fresh that, unless the birds lived a few years ago, they must have been preserved under specially favorable conditions; and there are reasons for thinking that the small district of Central Otago, in which alone these remains have been found, is one specially favorable for preserving animal remains. If this be so we cannot say for how many years they may have been preserved, perhaps for centuries, and as we have every reason to believe, upon the authority of the Rev. J. W. Stack, that the ancestors of the Ngai Tahu, who have inhabited the South Island for the last 200 or 250 years, never had any personal knowledge of the birds, we must allow that the Moa has been extinct for at least that time. On the other hand, it is quite certain that the Moa was exterminated by the Maoris, and the Maoris are not supposed to have inhabited the South Island for more than 500 years, so that the time of extinction must fall between these dates. It seems improbable that the Ngatimamoe, the last remnant of whom inhabited the West Coast sounds a few years ago, were Moa hunters. The moa hunters of the South Island were not cannibals, and as Te-rapu-wai and Waitaha, the tribes who preceded the Ngatimamoe, are said to have been peaceful and to have "covered the land like ants," it lends support to the Maori tradition that it was they who exterminated the Moa and made the shell heaps on the beach. If this be so the Moas were exterminated in the South Island about 300 or 400 years ago; that is, about a hundred years later than in the North Island.—*New Zealand Journal.*

EXPERIMENTAL EMBRYOLOGY.

By E. A. Andrews.

The accumulation of embryological facts and their application to problems of animal morphology from the days of von Baer to the period of Balfour's text book of Comparative Embryology was carried on with ever increasing speed culminating in the present day when the revision of Balfour's work by Korschelt and Heider assumes such unexpected proportions. Though the advance of descriptive embryology has been so great, the physiological aspects of the subject have been but little cultivated, partly to be sure, from the necessary dependence of such work upon the anatomical facts that were not at first available. Now, however, when the normal development is known for all groups of animals and comparative embryology stands upon a firm basis, the application of physiological methods, the introduction of experimentation into a field promising much richer harvest than the study of adults can hope to yield, may be no longer delayed. Knowing the changes of form that ova pass through to attain the adult condition may we not both eliminate such changes as are unessential and also press nearer to the solution of more fundamental questions by varying the condition of environment and the physical state of the ovum or embryo?

Interference with the normal course of embryological phenomena was no doubt often brought about more or less unconsciously, or at least incidentally, by many of the older embryologists and remarkable results sometimes attained. Only, however, within the present decade have systematic researches been begun, definite and thought-out experiments devised and finally predictable results attained by workers in the domain of what may be called experimental embryology, though as yet the methods and the subject matter are so differently conceived by various authors and the question involved so overlaps the regions assigned to other branches of Biology that the term has at best but a vague and changing significance.

Some of the researches in this subject seem to be of such interest, though but beginnings and liable to be wrongly valued one way or the other, that a review of them here may aid in calling attention to a comparatively new line of research, one that is as yet in the limbo of pathology and thus excluded from zoological and embryological text books.

Passing over numerous experimental investigations upon the hen's egg, some of which appear to have resulted in the formation of definite, predictable monstrosities from localized interference with the embryo, we will mention only the work of Leo Gerlack[1] who finally devised a movable window, embryoscope, that allows the chick to be observed and also experimented upon from time to time while continuing to live, at least for 13 days.

With the aid of this instrument embryological problems such as the origin of the vascular system from parablast or from the primitive streak may be approached experimentally, by destroying the primitive streak for instance. By similar methods the author hopes to produce changes in embryos of several successive generations and thus strive towards the selection of important questions in heredity.

It is the frog, however, rather than the chick which has given more decided answers to physiological inquiry promising to be in its early stages what it has become as adult, an easily accessible and not so excessively equivocable an oracle.

Professor Pflüger,[2] starting from the observed facts that frogs' eggs taken from the uterus and thrown into water, float at first with variously inclined axes but after fertilization turn so that the black pole is uppermost and the white pole downward and that when cleavage takes place the first and second planes are vertical, the third horizontal was led to inquire what connection there may be between cleavage planes and gravitation.

The method of investigation was simply to remove ovarian eggs with their gelatinous capsules and fix them by their own

[1]Leo Gerlack: Ueber neuere Methoden auf dem Gebiete der experimentallen Embryologie. Biol. Centb. 7, 1888, pp. 587–605.

[2]E. Pflüger: Ueber den Einfluss der Schwerkraft auf die Theilung der Zellen. Archiv. f. Phys., 31, 1883, pp. 311–318.

viscosity upon glass plates with the white ends upward; then fertilize them artificially by sperm in so little water that the jelly does not change sufficiently to allow the egg to rotate as it normally would, but keeps it with the white side upward. In such inverted eggs cleavage takes place: moreover the first and second plane are vertical, the third often abnormal, often at right angles to the other two.

This is true when the egg is much inclined or even horizontal, that is when the egg axis, or line joining the centers of the black and the white regions, is turned out of the vertical and the first and second plane no longer intersect at this line as they normally would. Later the neural folds often appear upon the upturned white pole and throughout this pole cleaves more rapidly than the lower pole, as is the case in a normal egg with black pole uppermost.

An entirely different problem was also solved by the same method. Seventeen eggs fixed in normal positions and kept three days till the neural groove and ridges were formed, gave the direction of the median plane of the future frogs. The plane of the first cleavage furrow having been previously indicated by lines on the glass the eggs were stuck to, it was found that in twelve cases the median plane of the animal coincided with the first cleavage plane, in four it made an angle of 30°–60° and in one an angle of 90°.

To return to the effects of gravitation: it seems from a second paper[3] that normal larvæ both of *Rana esculenta* and of *Bombinator igneus* were raised from eggs held inverted as well as some larvæ partly white on the dorsal surface and not normal enough to live long.

The medullary folds, normally upon the black pole, may be made to appear upon the white pole by inclining the egg axis. The author concludes that the egg is directed by gravity so that cleavage may take place in various planes of the egg according to the position of its axis with reference to the lines of gravitation or vertical plane. Moreover, these effects are seen later, the author thinks, in the origin of the blastopore

[3]E. Pflüger: Ueber den Einfluss der Schwere auf die Theilung der Zellen und auf die Entwicklung des Embryo. Archiv. f. Phys., 32, 1883, p. 1–77. Pl. 1–2.

just ventral to the equator of the egg. Normally the blastopore appears just ventral to the equator and passes, so Pflüger maintained, across the white pole to the opposite side of the equatorial region. In unusual positions the blastopore also appears just beneath the horizontal equator, whatever part of the egg this equator may be in the given inclined position.

Pflüger came thus to regard the essential elements of an egg as having no more prearranged relationship in position to the part of the future embryo than do "snowflakes to the avalanche they may give rise to." Gravity acting to arrange the parts of an egg according to circumstances, much as snowflakes may be collected by gravity to form an avalanche, under certain circumstances.

The fundamental character of these experiments seems to be upheld by the fact presented in a third paper[4] that eggs thus held in oblique positions actually developed as far as the adult shape, quite normal toads being reared from eggs of *Bombinater igneus.*

Moreover other forces than gravitation act in the same directive fashion upon the cleavage, for Pflüger mentions his repetition of certain experiments of Rauber upon trout eggs, using eggs of both *Rana* and *Bombinator* and finding that in a rotating machine the centrifugal force controlled the appearance of cleavage planes.

Frog's eggs compressed between vertical plates of glass cleave at right angles to the plates and generally in the vertical plane also, but in exceptional cases at all angles to the vertical plane: here pressure is assumed as a sufficient determining influence.

The frog's egg is thus regarded as directly influenced by external forces and fundamentally altered in the arrangements of its constituents. The egg is like a mass of porridge with its outer part firmer and its main mass perhaps traversed by some reticulum of firmer material, but still so mobile that the heavier yolk can sink to the bottom and the less heavy remain above it, much as sediment falling in a liquid.

[4]E. Pflüger: Ueber die Einwirkung der Schwerkraft und anderer Bedingungen auf die Richtung der Zelltheilung. Archiv. f. Phys., 34, 1884, pp. 607–616.

That this conception of the egg does not fulfil all the requirements might have been argued from the statement of Pflüger himself that the eggs experimented upon successfully, were inclined, but if placed exactly inverted with only the white pole upward, failed to develop.

It remained for Born[5] to show in what sense gravitation may be said to have anything to do with the direction of the cleavage plane and how the development of neural ridges upon what was the white pole can be brought about without there being any interchange of function between the normal neural side of the egg and the abneural white side.

Eggs fastened in an inclined position with the white showing become grey in from three quarters of an hour to two hours after fertilization. This change in appearance is due to an actual rearrangement of material beneath the firmer superficial layer of the egg, white or dark on opposite poles. The dark colored material of the egg is not confined to the surface of the dark pole, but there penetrates far towards the center in a symmetrical mass enclosing some light yolk near the center of the dark pole.

When the egg is inclined this darker material rises upward along one side of the sphere, carrying the enclosed white yolk with it, while the heavier white yolk flows down on the other side of the sphere from its forced position to a more normal one. Thus the material normally at the upper pole is brought there again, though covered over still by some superficial white yolk that remains over the white pole, now become grey.

When this rearrangement takes place at so late a stage that the nucleus is dividing as it rises, then the first plane is not necessarily vertical; gravitation acting only indirectly, while other causes determine the direction of the first cleavage plane.

Roux[6] had drawn the same inference as to the insignifi-

[5]C. Born: Biologische Untersuchungen. I. Ueber den Einfluss der Schwere auf das Froschei. Archiv. f. Mik. Anat., 24, 1885, pp. 475–540. Pl. 23–24.

[6]W. Roux: Beiträge zur embryonal Entwicklungsmechanik. 2. Ueber die Entwicklung der Froscheier bei Aufhebung der richtenden Wirkung der Schwere. Bresl. Arz. Zeit., 1884, No. 6.

cance of gravity as well as light, heat, magnetism in directing the cleavage processes from rotation experiment upon frogs' eggs. Using a vertical wheel, revolving rapidly enough to produce centrifugal effect, about double that of gravitation, he found the eggs develop normally, though constantly presenting their white poles away from the centre of the wheel and being thus acted upon alternately above and below, by gravitation. Having eliminated the constant action of gravity as a directive force, he concluded it was unnecessary for the appearance of cleavage planes and assigned this to causes within the egg.

By numerous other contributions and complete devotion to a definite line of embryological research, this author has become as it were, the apostle of a new branch of embryology, *Entwicklungsmechanik.* Judging from the heterogenous character of the 262, 384, and 277 works for 1887, '88, '89, ranged under the above heading, as forming a separate department in Hermann and Schwalbe's *Jahresberichte* we conclude that this term is by no means synonymous with physiological or with experimental embryology, but has a much wider application, including the last as one of its subdivisions.

The first definite use of the term together with outlines of the problems to be attempted in this pre-determined field of work was made by Roux in 1885[7]. We there find *Entwicklungsmechanik* to be the science of the character and action of the combinations of energy which produce development. Also, development being the origin of observable multiplicity, there may be either read production of or merely transformation of non-observed into observable manifoldness. Epigenesis is then the actual creation of complexity: Evolution only the sensualization of latent diversities.

The key to the causal knowlege of development lies in the determination of the relative value of two possibilities: self-differentiation: interaction with the environment. Self-differentiation of a system of part is the result of the energy of the system itself. Correlative differentiation is the change of a

[7]W. Roux: Beiträge zur Entwicklungsmechanik des Embryo. Zeit. f. Biologie, 21, 1885, pp. 411–524.

system from loss or advent of energy from without, provided these changes are specially determined by this outside energy.

To determine what external forces might be at play in embryological phenomena he had thrust large pins into frog larvæ, fastening them to wax under water, in the expectation that any electrical condition of the surface would be changed by the addition of a good conductor. As some of the tadpoles developed normally he inferred the electrical state of the surface of the body was not a determining cause in the processes of growth. In this work he found certain abnormal changes in the surface cells when death took place and subsequently made use of these as a means of determining the condition of cells in early stages where there were no movements. The chief result appears, however, to have been the suggestion of a method afterwards very extensively employed.

Thus as early as 1882 he thrust needles into frogs' eggs to see if the protoplasm were arranged corresponding to the future differentiations, though recognizing the roughness of such attempts which he likens to the casting of a bomb into a factory, in hopes of drawing conclusions from the resulting changes in productivity, as to the character of damage inflicted.

On withdrawing the needle point from an egg a mass of black, or black and white yolk exudes at once and may afterwards be increased. This *extraovate* either remains connected with the wound by a narrow stalk or else separates and leaves no discoverable trace of the wounded spot. In extreme cases, one-fourth to one-fifth of the bulk of the egg may be thus lost, yet development may proceed.

Regarding the effects of wounding we find, in general, a large number of eggs develop normally, though many embryos formed are weak and small, but there are many abnormalities, some of which are like those often met with in eggs not operated upon, while others are rarely if ever found in nature. Operation at different stages produces results as follows:

Injured before cleavage had begun the eggs developed abnormally in many cases, forming larvæ with deformed

heads, absent medullary folds, etc. After the first cleavage the second plane often passes through the wound and after the second cleavage one plane sometimes changed so as to pass through the wound now made. The resulting embryos often have circumscribed areas of deficient development. When injured after the equatorial plane was formed normal tadpoles were found amidst abnormal ones.

Operations after the fourth, fifth and sixth planes have appeared show that injury to the black pole produces defects in the region of the medullary folds. Blastulæ injured nineteen hours after fertilization show fewer cases of circumscribed defects. In addition it is to be noted that the exuded part of the egg may undergo by itself, a sort of cleavage resulting in the formation of a mass of numerous cells.

It thus appears that all the material of an egg is not necessary to form a normally shaped embryo: that rough mechanical disturbance of the egg material does not produce complete irregularity in the subsequent arrangements of organs: that circumscribed injuries often produce circumscribed defects and that about the same effect results whatever stage of cleavage is injured.

The author, however, does not know why the defects are sometimes absent, nor can he produce the same defect at pleasure, in different experiments. Yet the methods of injuring definite areas of the egg is made use of in referring the cleavage planes to the axes of the subsequent embryo. Thus when eggs in the two celled stage have the needle thrust into them in the black pole, at the uppermost part of the border between black and white, the egg being naturally inclined, a circumscribed defect appears posterior to the middle of the medullary folds, whence we see that the posterior part of the medullary folds were formed over what was the white pole and the third plane divides head from tail substance.

But this question of axes and position of embryo will be dealt with later on in connection with other experiments.

The gastrula also was injured by the needle, but with conflicting results as to the circumscribed nature of the resulting defects. Deep cuts made into the gastrula yield the interesting

result that each newly severed part may form its portion of the medullary fold separately. Development continued even when large tongue-shaped pieces were completely cut out. When the medullary fold region is cut lengthwise, a double-tailed monster was sometimes formed.

Larvæ with the medullary folds formed, completely cut into two, regenerate to the slight extent that an epithelial border may be formed around the rim of the wound. When cuts are made upon the ventral side the wound may heal over completely.

In all the gastrulæ and later stages the wounds led to little loss of material unless continued into the yolk mass. No subsequents defects in ectoderm were found, the wound healing over or remaining open with no formation of new ectoderm from the underlying layer. When life continued, the development was often normal though tumors were found in some cases.

Roux sees in many of the above experiments evidence for the importance of self differentiation as a principle in embryology, and also emphasizes the self regulation there observed as the most essential common character of organisms.

The interaction of the various parts of an embryo may fall under various heads not understood, but there are three chief methods insisted upon by Roux. These are functional adaptation, struggle of organs, and mechanical mass correlation.

This last factor was emphasized by Prof. His who laid stress upon the elasticity of the germ layers as an agent in bringing about folding, etc. Roux has, however, made experiments that tend to limit the application of this principle. Thus frog embryos cut into pieces showed no bending as would have resulted if there had been a tension of the surfaces. Again in a chick forty hours old the removal from yolk did not cause any gaping open of the medullary folds such as would be expected if lateral pressure had brought them about: in fact a younger embryo proceeded to form its folds even after removal, by self differentiation not by mass correlation evidently.

Then His' derivation of the the fourth ventricle from a bending of the brain, is not supported by experiments upon frogs and chicks in which, to be sure, a ventricle-like fold was produced by actual bending; but this was not in the position of the fourth ventricle and was, moreover, the result of the reaction of the living substances, not simply mass correlation.

An ingenious research into the cause determining the direction of the first cleavage plane in the egg and hence the median plane of the adult frog, as it is thought, was subsequently published in full by Roux[8] in 1887.

The method employed was simply to place eggs from the oviduct upon glass, white pole downward and allow them to adhere. Then sperm was added either by touching a cut made in the jelly with a brush moistened by sperm or else by introducing sperm through a capillary tube into one point of the jelly. Examined at frequent intervals the appearance of the cleavage planes was noted and referred to marks made upon the glass or paper under egg.

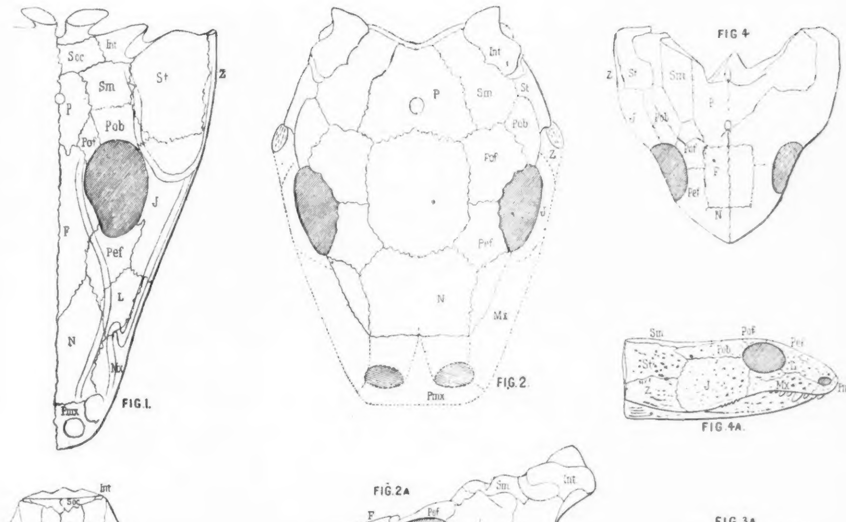
When the eggs were fastened in the normal position and were not eggs laid late in the season, when abnormalities are frequent, the following results were obtained:

Before fertilization but one axis of the embryo is indicated in the egg: the main axis of egg, that from black to white pole representing the ventro-dorsal axis of the actual embryo, which the author believes has its neural folds formed upon the white pole when held in a normal position. Yet this axis corresponds to a cephalo-caudal direction of the embryo when we consider the rearrangement of material that takes place during gastrulation. Of the infinite planes passing through this axis that one becomes the median plane of the frog which is determined by the plane of copulation of the male and female pronuclei. This plane of copulation in turn is not predetermined but may be put in any meridian by localized fertilization.

The side selected for entrance of sperm becomes the ventro-

[8] W. Roux: Beiträge zur Entwicklungs mechanik des Embryo. IV. Die Richtungs-bestimmung der Medianebene des Froschembryo durch die Copulation richtung des Eikerns und des Spermakerns. Archiv. f. Mik. Anat., 29, 1887, pp. 157–211. Pl. X.

PLATE XV.



1. *Mastodonsaurus* Jaeger. 2. *Chilonyx* Cope. 3. *Pariotichus* Cope.
4. *Pantylus* Cope.

caudal and the opposite the dorso-cephalic side of the embryo. An examination of these eggs by sections shows that the course of the sperm as indicated by the trail of dark pigment left behind it is first a long radiating line from the black pole near the white rim to a layer deep within the egg in which the copulation of nuclei takes place, then a short course towards the female nucleus.

The author then points out that the cleavage in the plane of copulation ensures an easy separation of the material of both pronuclei, provided they are not intermixed in copulation, half of each being readily moved into each of the resulting cells.

When, however, the eggs are held inclined more than 20°–30° the above rules do not hold good. Though even here the first cleavage seems to coincide with the plane of copulation of nuclei, yet these are often at right angles to the future median plane of the frog, though they may coincide with it in some cases. This is to be explained on the assumption that gravity acting upon yolk and nuclei determines a rotation of copulation direction.

Again in these much inclined eggs the lowest side of the black pole becomes the ventro-caudal part of the embryo, possibly because the formative yolk may accumulate there and influence the nuclear cleavage.

The most interesting of Roux's contributions appeared a year later.[9] In this he follows out the question of self-differentiation of the embryo, seeking to determine the amount and character of interaction of the part of an egg by destroying or injuring definite cells during cleavage. The eggs of *Rana esculenta* in the two celled stage were at first simply stabbed by a fine sharp needle, thrust into one cell, but as this did not produce much injury the needle was heated and often moved about inside the cell. Of such eggs about 20 per cent. developed only from the uninjured cell, others went to pieces or else developed normally. It is to be noted also that at this

[9] V. Beiträge zur Entwicklungsmechanik des Embryo. Ueber die kunstliche Hervorbringung halber Embryonen durch Zerstörüng einer der beiden ersten Furchungs-kugeln, sowie über die Nachentwicklung der fehlenden Körper-hälfte. Virchow's Archiv., 114, pp. 113–153, 246–291. Pl. 2–3.

time of year, the latter part of the spawning season, some similar abnormalities were found in eggs that had not been operated upon at all. The various stages of abnormal growth were hardened, stained and sectioned. The results of such injury may be considered, first as relates to the uninjured and then to the injured half of the two celled stage.

The single cell by side of the injured one develops in many cases into a half embryo, first a half blastula, a half gastrula then a half embryo with medullary fold, archenteron, chorda, mesoblast and metameres representing only half of the normal condition of these organs.

In the four-celled stage injury to both posterior cells sometimes resulted in formation of only anterior half of medullary folds. Injury to three or to one of the cells resulted either in one-fourth blastulæ or in the other cases three-fourths embryos. Finally injury above or below the first horizontal furrow gave rise to some cases of upper half blastulæ.

He concludes that as each of the first two cells may develop up to stage of medullary folds without aid from the other, there is marked self-differentiation and that the cleavage planes separate the material qualitatively and thus determine the subsequent position of the organs. The last experiment also indicates that the gastrula or embryo is a mosaic made up of at least four vertical elements or independent parts.

Turning now to the complex phenomena that take place in the cell operated upon, regarded by Roux as dead, though evidently this is scarcely justifiable from its subsequent history we find three series of events taking place: 1st disintegration, 2nd reorganization, 3d post generation.

In the first category are included, a vacuolation of the yolk, the appearance of a net work within it in places and the formation of peculiar bodies regarded as nuclei derived from the original nucleus of the operated cell. Here again we must not overlook the fact that some eggs found at this season do not develop but have similar abnormal nuclei. Only about one-third of the eggs operated upon and subsequently sectioned present these phenomena of disintegration.

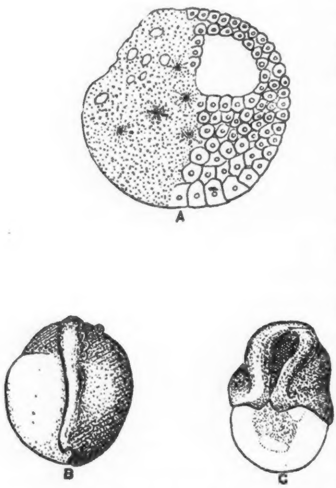
In all the operated eggs there are normal nuclei present in the half that was injured and these come in part from the original nuclei and in part by migration from the uninjured half, at least so the author concludes. These normal nuclei undergo further development and are associated with cell walls in the process of reorganization, the abnormal nuclei on the other hand collect in clusters and go to pieces. Where these abnormal nuclei and the vaculated nuclei are present reorganization of the yolk is delayed for some time but elsewhere the yolk presents rearrangement of its granules leading to the formation of cell walls. Besides the formation and arrangement of normal nuclei and the reconstruction of the yolk there is a third process in the reorganizations, namely the growth of cells from the uninjured half over the injured half or at least over such parts of it as present vaculated yolk. All three processes may take place at once or separately.

Post generation is the completion of the half of the embryo in which the above nuclear changes have regenerated the mass apparently killed by the injury of operation. It is externally manifested by the formation of a layer of pigmented cells over the operated half, the formation of the missing medullary fold which grows from before backward or of the posterior parts of both folds when we have an anterior half embryo. The complete tadpoles resulting are in part active, in part weak, easily killed creatures.

The internal changes that take place in this post generation as revealed by sections are the growth of a new ectoblast and mesoblast into the previously imperfect cellular mass by a process of successive rearrangement and differentiation of the yolk cells, adding themselves to the edges of the advancing layers in such wise as to form parts symmetrical with those in the uninjured half of the embryo. The entoblast also is formed from the free edge of the entoblast of the perfect half by rearrangement of yolk cells and there is no invagination, no gastrula nor blastula cavity formed in this newly forming half of the embryo. The germ layers thus form by a sort of regeneration from the interrupted surfaces of the old germ layers, but as the material comes from the new half of the

embryo the old half may be regarded as exercising a sort of formative or assimilative action upon the irregular mass of yolk cells in the new half.

FIGURE I.



To recapitulate the chief results with the aid of fig. 1, A, B, C: A, being a half blastula resulting from injury of one of the first two cleavage cells and as yet not reorganized, seen in section: B, a right half larva from dorsal view and C are anterior-half larva. Injury to one of the first cleavage cells may result in the formation of a half embryo, to one of the first four to a fourth embryo, to three of the first four to a three-fourths embryo. The dead cells (regarded as dead by the author) may be revived and reorganized partly by division of the nucleus present and partly by inwandering of new nuclei and their division. The nucleation is followed by a cellulation and this by a regeneration of germ layers not following the normal course but growing out from the exposed surfaces of the layers already formed in the other half of the embryo. This definite process of post-generation seems due to the controlling action of the formed germ layers upon nuclei and yolk collected by chance in the places they occupy before being thus incorporated with the germ layers. Thus the reorganized parts are not capable of self differentiation as are the early cells in cleavage but are dependent upon influences coming from the other half of the egg or embryo.

An earlier paper by the same author, Roux,[1] has led to inter-

[1]W. Roux: II Beiträge zur Entwicklungsmechanik des Embryo. 3 Ueber die Bestimmung der Haupt-richtung des Froschembryo im Ei und die erste Theilung des Froscheies.

Breslauer arztliche Zeitschrift, 7, 1885. 1. nrs, 64–68, 73–77, 87–88, 100–101, 112–116, 125–128.

esting facts and discussions regarding the axial relations of egg and embryo in the frog. In these experiments the eggs were put into semen for four minutes, then provided with a hair inserted into the gelatinous envelop as an index of movement and floated in a solution of gum arabic contained in a vessel of mercury that thus enabled one to see the reflected image of the under side of the egg. The eggs now take up a definite inclined position but subsequently, in 13 to 30 minutes change so as to stand vertically. Control experiments with eggs not fertilized show that the change in position does not take place as a rule. Hence fertilization is regarded as bringing about an alteration in the egg axes with reference to the lines of gravitation. The first cleavage plane would then pass through the egg in its secondary position which has been brought about by the entrance of the sperm. This led to the experiments previously reviewed, on the determination of the first plane by the plane of copulation of the nuclei.

The validity of conclusions drawn from observations upon eggs in gum solutions is obviously, as Schultze has pointed out, very doubtful, especially when we find that of 47 eggs only 8 formed even the first cleavage plane and the inclination of these eight eggs in the gum was so obviously influenced by it, being 90°, 60°, 50°, 50°, 30°, 20°, 20°, 20°.

In another part of this paper it is found that frogs' eggs drawn out to double their normal diameter in narrow glass tubes assume a conical or else a lens shape, but cleave and at first transverse or at right angles to the tube, in the line of pressure. Again eggs in larger tubes wound about by wire through which an electric current was passing show no difference from the normal cleavage. The same is true when the eggs are between the poles of a magnet. Incidentally it was found that the eggs left in the tube did not continue development unless close to the air, at ends of tube or next bubbles, the position of organs formed or at least the gastrula mouth has, however, no reference to the side whence the air supply came.

With Pflüger, Roux finds the first cleavage plane is the median plane of the frog, yet not without exceptions since the normal sequence may be interrupted and the first plane act-

ually found separate the anterior from the posterior part and thus represent the normal second plane. Rauber[2] it is to be noted, found somewhat similar irregularities. Thus in the frog the first plane in seven eggs made the following angles with the future median plane of the adult, 90°, 50°, 90, 85°, 0°, 82°, 90°. In the axolotl the same angles were, 80°, 53°, 90°, 50°, 90°, 30°, 90°, 2°, 90°, 90°, 70°, 80°, 32°, 90°, 90° in fifteen eggs observed.

Another point that appears to offer unusual difficulties to the experimentator is connected with the movement the egg performs after the embryo begins to form, which render the reference of organs to special regions of the egg by no means easy. Thus Roux[3, 4, 5] and Schultze working upon similar material by similar methods arrive at very different conceptions of the relationships of the dorsal and ventral parts of the frog to the white and black parts of the egg.

Roux holds that the medullary folds, that is, the dorsal region of frog, appear upon the white or lower pole. This is seen when eggs are fastened in normal positions and is also inferred from experiments in which injury to the black pole remains as injury to the ventral side of the embryo. The reason other observers find the dorsal area on the upper black pole is that the egg turns over so that the dorsal field floats uppermost. The blastopore first appears just beneath the union of black and white, the equator, and then shifts over while closing to the opposite side of the equator. Where the blastopore first appears arises the anterior end of the medullary plate and extends across the white pole to the closing region of blastopore. All this is on lower side when egg is fixed, but the free normal egg turns upward so that the region of first appearance of blastopore rises and carries the head area into the uppermost pole where the black pigment was at first.

(*To be continued.*)

[2]A. Rauber: Furchung und Achsen-bildung. Zool. Ang. 9, 1886, p, 157–9.

[3]W. Roux: Zur ersten Entwicklung des braunen Grassfroches. O. Schultze, Biol. Centb. vii, 1888, pp. 421–424.

[4]W. Roux: Zur Frage des Axenbestimmung des Embryo im Froschei. Biol. Centb, viii, 1889, pp. 399–412.

[5]W. Roux: Ueber die Lagerung des Materiales des Medullarrohres im gefurchten Froschei. Anatomische Anzeiger iii, 1888, pp. 697–705, figs. 1–4.

RULES OF NOMENCLATURE ADOPTED BY THE INTERNATIONAL ZOOLOGICAL CONGRESS HELD IN PARIS, FRANCE, 1889.

Translated from the French by Moritz Fischer.

I. Nomenclature.

1. The nomenclature adopted for organisms is a binary and binominal one. It is Latin or latinized. Each organism is distinguished by a generic name, followed by a specific name as: *Corvus corax.*

2. In case varieties must be distinguished, the use of a third name is permitted, as: *Corvus corax kamschaticus.*

3. Since it would be wrong to write *Corvus kamschaticus* the insertion of the word *varietas* or its abbreviation *var.* between the specific and the varietal name is not essential.

4. When the word *varietas* is used, the name of the variety agrees with it as: *Corvus corax var. kamschatica.* If the word *varietas* is omitted, the varietal name agrees with the generic as: *Corvus corax kamschaticus.*

II. Generic Names.

5. Generic names should consist of one word, either simple or compound, but always written as one, whether Latin or latinized.

6. Generic names may be derived from :

(a) Greek nouns. These should have the correct Latin spelling as: *Ancylus, Amphibola, Aplysia, Pompholyx, Physa, Cylichna.*

(b) Compound Greek words. In using these the adjective must be placed before the noun as: *Stenogyra, Pleurobranchus, Tylodina, Cyclostoma, Sarcocystis, Pelodytes, Hydrophilus, Rhizobius.* It is permissible to place the adjective after the noun as: *Hippopotamus, Philydrus, Biorhiza.* Names so formed are inelegant and should not be imitated.

(c) Latin nouns as *Ancilla, Auricula, Cassis, Conus, Dolium, Metula, Oliva.* Adjectives (*Prasina*) and past participles (*Productus*) should be avoided.

(d) Compound Latin words as: *Stiliger, Dolabrifer, Semifusus.*

(e) Greek or Latin derivatives expressing diminution, comparison, resemblance, possession, as: *Lingularius, Lingulina, Lingulinopsis, Lingulella, Lingulepis, Lingulops,* all derived from *Lingula.*

(f) Mythological or heroic names as: *Osiris, Venus, Brisinga Velleda, Crimora.* Such names, if not Latin, take a Latin termination as: *Aegirus, Gondulia.*

(g) Names used by the ancients as: *Cleopatra, Belisarius, Melania.*

(h) Modern patronymics. These take an ending to indicate dedication.

Patronymics taken from Latin and Germanic tongues retain their original spelling including diacritic marks.

Names terminating with a consonant take the ending *ius, ia, ium* as: *Selysius, Lamarckia, Köllikeria, Mülleria, Stålia, Kroyeria, Ivañezia.*

Names terminating with the vowels *e, i, o, y,* take the ending *us, a, um* as: *Blainvillea, Wyvillea, Cavolinia, Fativa, Bernaya, Quoya.*

Names terminating in *a* take the ending *ia* as: *Danaia.*

Names ending in *n* or *ean* follow the preceding rule but take a euphonic *t* as: *Payraudeantia.*

(i) Names of ships which take the same terminations as the mythological names (*Vega*) or the modern patronymics as: *Blakea, Hirondella, Challengeria.*

(j) Barbaric names taken from languages spoken by uncivilized races as: *Vanikoro.*

Such names must take a Latin ending as: *Yetus.*

(k) Words formed by arbitrary combination of letters as: *Fossarus, Neda, Clauculus.*

(l) Names formed by anagrams as: *Vertusia, Linospa.*

7. With patronymics consisting of two words only one of these is used as: *Selysius, Targionia, Moquinia, Edwardsia, Duthiersia.*

8. In generic names formed from modern patronymics the particles are omitted, the articles are retained as: *Selysius, Blainvillea, Lacazea, Lacepedea, Benedenia, Chiajea.*

This rule does not apply to modern patronymics in which the particle has united with the noun as *Dumerilia.*

9. The names specified in article 6, paragraphs f, g, h, and i, should not be used to form compound words. Generic names such as *Eugrimmia, Buchiceras, Heromorpha, Mobiuspongia,* are not elegant.

10. Generic names already existing in botany should not be used in zoology and *vice versa.* A certain number of such names is now common to both kingdoms and does not cause serious inconvenience as: *Balanus, Myrrha, Hagenia, Mirbelia.*

III. Specific Names.

11. Specific names, whether nouns or adjectives should consist of one word only. It is, however, permissible to use compound modern patronymics or compound words indicating comparison as: *sanctæ-catarinæ, zan-mayeni,. cornu-pastoris, cor-anguinum,* etc. In using compound names the two words must be united by a hyphen.

12. Specific names can be divided into three classes:

(a) Nouns and adjectives descriptive of a certain characteristic of a species (form, color, origin, habitat, use, habits, etc.) as *cor, cordiformis, gigas, giganteus, fluviorum, fontinalis, edulis, piscivorus, flavipunctatus, albipennis.*

(b) Names of persons to whom a species is dedicated. These names must be put in the genitive. The genitive is always formed by the addition of *i* to the full name of the person to whom one dedicates as: *cuvieri, linnei, cotteaui, muelleri, sebai, rissoi, pierrei.*

In case the name applied is a given name or a surname which has been used and declined in Latin it follows the rules of declension as: *plinii, aristotelis, victoris, antonii, elisabethæ, petri.*

(c) Names in apposition with generic names and constituting a sort of prenomen as: *leo, coret, hebe, napoleo, arctos, calcar.*

13. A Latin adjective is best adapted for a specific name, it should be short, euphonic and of easy pronunciation. It is, however, permissible to use latinized Greek words or indeclinable barbaric words as: *hipposideros, echinococcus, zigzag.*

14. The specific name must never be a repetition of the generic name as: *Trutta trutta.*

In case a varietal name is used it must never be a repetition of the specific name as: *Amblystoma jeffersonianum jeffersonianum.*

15. The prefixes *sub* and *pseudo* can be used with adjectives and nouns only, *sub* with Latin adjectives, *pseudo* with Greek nouns as: *subterraneus, subviridis, pseudacanthus, pseudophis, pseudomys.*

These prefixes cannot be used with proper nouns. Words like *sub-wilsoni, pseudo-grateloupana* are barbarous.

16. The termination *eidos* or its Latin form *oides* can be used only with Latin or Greek nouns. They cannot be used with proper nouns.

17. If the specific name requires the use of a geographical name this must be put in the genitive, or its adjective form must be used if it was known to the Romans or latinized by the writers of the middle ages. Used as an adjective it must be written with a small letter as: *antillarum, lybicus, ægyptiacus, graccus, burdigalensis, iconensis, petrocoriensis, parisiensis.*

18. All geographical names which do not come under the preceding category must be changed into adjectives following the rules of Latin derivation and retain the exact spelling of the radical if this has not been used in Latin as: *neo-batavus, islandicus, brasiliensis, canadensis.*

19. If from the radical of the geographical name two Latin adjectives have been derived as *hispanus* and *hispanicus* they both cannot be used in the same genus.

20. This rule also applies to common names as: *fluviorum, fluvialis, fluviatilis.*

21. In transforming into Latin adjectives the names derived from the various languages using the Latin alphabet such as the Neo-Latin and Germanic tongues, the original spelling is retained and likewise all diacritical marks as: *spitzbergensis, islandicus, paraguayensis, patagonius, barbadensis, färöensis.*

22. Geographical names derived from names of persons are transformed into Latin adjectives according to rules 18 and 19 as: *edwardiensis, diemenensis, magellanicus.*

The name of islands such as St. Paul, St. Thomas, St. Helena, can retain their noun form but must then take the genitive ending as: *sancti-pauli, sanctæ-helenæ.*

IV. Writing of Generic and Specific Names.

23. The generic name must be written with a capital letter.

24. The specific name takes either ac apital[1] or a small letter in conformity with the rules of spelling as: viridis, magnus, Cuvieri, Caesar.

25. The author of a species is he who:

(a) First describes and names the same according to Section I.

(b) According to the same section names a species already described but still unnamed.

(c) Substitutes for a name not agreeing with Section I a name agreeing with said section.

(d) Substitutes for a specific name used twice a new name.

The name of the author of a species follows the specific name and is written in the same characters as the text; if the text is Roman, the name of the species is in italics and vice versa as: La *Rana esculenta* Linne vit en France.

26. When the name of the author of a species or a subspecies is cited and abbreviated, the list of abbreviations proposed by the Zoological Museum of Berlin must be used.

V. Division and Consolidation of Species.

27. When a genus is sub-divided the old name must be retained in the sub-division which contains the original type.

28. When the original type is not clearly specified the author who first sub-divides the genus can apply the old name

[1]The rule of the *American Naturalist* is *invariably* to begin the specific name with a small letter. Otherwise there can be no uniformity. According to the rules of English capitalization we would write *Cardium cor* and *Cervus Canadensis;* the Germans would write *Cardium Cor* and *Cervus canadensis.*—Ed. Am. Nat.

to whatever sub-division he may select and this application cannot be changed subsequently.

29. The division of species is subject to the two preceding rules.

30. If in consequence of the division of a genus, a species is put into one of the divisions of the primary genus, the name of the author of the species must follow the specific name. Several notations are in use which we insert below in the order of their merits, taking as an illustration the old *Hirudo muricata* Linne, 1761, placed in the new genus Pontobdella by Leach in 1815:

1. *Pontobdella muricata* Linne.
2. *P. muricata* (Linne).
3. *P. muricata* Linne (sub *Hirudo.*
4. *P. muricata* (Linne) Leach.
5. *P. muricata* Leach ex Linne.

31. A genus formed by consolidation of several old ones takes the name of the oldest of them.

32. This rule applies when several species are consolidated into one.

33. When, in consequence of consolidation of two genera, two organisms, having the same specific name, are found in the same genus, the most recent receives a new name.

VI. Family Names.

34. Family names are formed by adding the ending *idæ* to the radical of the genus serving as type. The sub-divisions of the family are named by adding the ending *inæ* to the name of the genus serving as type.

VII. Law of Priority.

35. The name originally given to each genus and species is permanent, provided:

(a) The name has been announced in a publication in which it has been distinctly and sufficiently defined.

(b) The author has properly applied the rules of binary nomenclature.—E. M. Museum, Princeton, New Jersey, Nov. 14th, 1891.

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Continued from Vol. XXV, p. 311.

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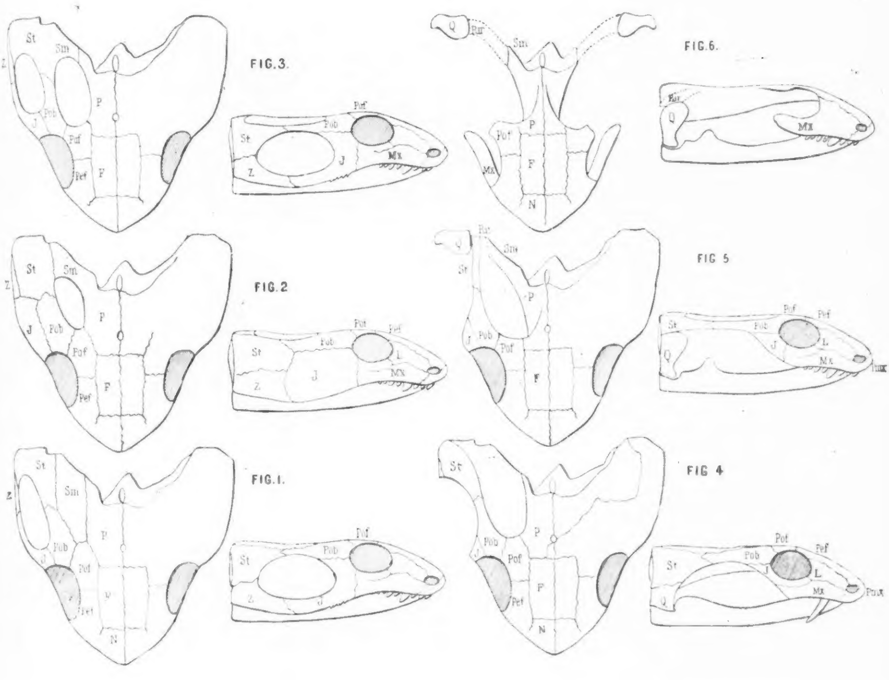
PLATE XVI.



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EDITORIALS.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

—THOSE Western State Universities which are situated in the smaller towns labor under great disadvantages. They are not in position to attract the attention of the greater body of educated men in the State, while they are peculiarly exposed to the influences of local politicians and the like. There seems to be a feeling upon the part of the townspeople that in some way the State institution is their exclusive property and that their wishes should be final in all matters relating to its management. In case any of the professors fail to fit in with the local political or religious tendencies, steps are taken by the whole community to make his position disagreeable, while not infrequently underhanded measures result in the resignation of the undesirable persons. These remarks are suggested by the recent history of the State University of Missouri. Some three or four years ago the Legislature of that State, in the course of some resolutions upon the condition and objects of the University, quite pointedly told the citizens of Columbia that the University was not their peculiar property. Apparently the hint was wasted, for the present special Legislature has called for bids from the various cities of the State looking towards a new location for the institution. All friends of education can but hope that the new situation will prove more favorable than the old, for so far in its history—whether the result of Columbian influence or not the University has produced no results at all commensurate with the outlay upon it. It is hardly necessary to say that the University of Missouri is not alone in its unfortunate situation.

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RECENT LITERATURE.

Heliotropic Animals.[1]—In connection with the work of Prof. E. B. Wilson upon the heliotropism of Hydra, (AMERICAN NATURALIST, May, 1891,) a brief review of the present paper of Dr. Loeb and some notice of other contributions to the same subject by the same author may not be without interest as pointing out the wide extension of such phenomena amongst animals and their identity with those commonly observed amongst plants.

The author's thesis is that experiments demonstrate a complete agreement between the movements that animals perform under the influence of light and those that have been demonstrated in plants.

Following Sachs the heliotropic phenomena of plants are briefly reviewed as follows:

Stems and roots which bend to or from the source of light until they take the *direction* of the light, are said to be positively or negatively heliotropic. That this bending is not simply a process of greater growth on the more shaded side is shown by the fact that negatively as well as positively heliotropic plants grow more in the dark.

That the direction of the light is the determining movement is seen in the actual locomotion of many spores to or from the light.

The more highly refrangible rays, blue and violet, are the active ones in producing heliotropic movements.

Movements within a single cell result in the arrangement of chlorophyll bodies with reference to the direction of the incident light and as all plants are to be regarded as a continuously connected set of cells, or as one protoplasmic mass, the true explanation of heliotropic movements may invoke a movement of negative protoplasm away from and of positive protoplasm towards the light.

In plants, then, light produces an orientation dependent upon its direction and upon its character, wave length, etc., and continues to act a stimulus when of constant intensity.

A brief survey of the previous work upon heliotropism in animals serves to point out the insignificance of the results achieved.

Réaumur, 1748, and Trembley, 1791, made direct observations upon the effect of light upon moths and Hydra, but no extensive examination of the subject was attempted. Later Bert, 1869, Lubbock, 1883, and Graber, 1884, made extensive researches into the action of colored

[1]Dr. J. Loeb: Der Heliotropismus der Thiere. Würzburg, 1890.

light and light of varying intensity, but arrived at results that are to be objected to as too strongly implying the conscious action rather than the mechanical reaction of the animal when effected by light. Their anthropomorphic nomenclature, use of terms implying a preference for or love of one form of light and the method of determining this preference by taking the majority vote of the animals experimented upon, stands in striking contrast to the work of Stahl, 1880, and Engelmann upon Infusoria, for here we find the movements of orientation of the animal ascribed to the directive influence of the light, not to the animal's choice.

Dr. Loeb's experiments are conducted with the greatest simplicity of apparatus and the results are at once evident, yet it is to be borne in mind that animals may not exhibit heliotropism except at certain stages of their existence and even then the reaction to light may be neutralized or modified by the co-existence of other modes of stimulation. Thus insects respond, it seems, to peculiar contact stimuli in such manner as to place their bodies with reference to adjoining surfaces; some for instance, taking up positions upon projecting corners of a box, others only in the hollow angles.

The form of reaction to contact stimuli is distinguished as "Stereotropism" and together with geotropism will be later seen to play an important role in the resulting movements of animals when exposed to light.

The fifth section of the brochure deals with the experiments upon the caterpillars of *Porthesia chrysorrhœa* and serves as an introduction and detailed illustration of the methods and results subsequently described in other cases.

The experiments are as follows:

About 100 small caterpillars that have escaped from the nest in which they pass the Winter and which have not as yet taken food, are put into a test tube in a room at 12°–15° C.

When placed horizontally upon a table covered with black paper and with the axis of the tube at right angle to the window the caterpillars all crawl toward the window on the upper side of the tube, the head and ventral side directed towards the light; reaching the end of the tube they remain pointing towards the light.

As often as the tube is turned through 180° the caterpillars repeat the movement. If then the test tube is put parallel to the window the caterpillars scatter all along it but only upon the upper side. When in the first position the animals have collected at the window end of the tube they leave that end as soon as it is covered over by an

opaque object and crawl towards the lighted end, but as soon as they emerge from the obscured region they turn about with the head towards the window and remain thus at the boundary of obscured and illuminated parts of the tube—not scattering through the latter part.

By leaving a small area uncovered along the upper side of the obscured part of the tube when it is turned to the window, the caterpillars continue on into this region as if it were not covered at all, though passing towards the window from a more generally illuminated part of the tube into one only illuminated from a narrow line. They move along the upper side with ventral aspects towards the light.

All the experiments were conducted in diffuse daylight but succeed the same, though more rapidly, in direct sunlight. One other experiment upon the relation of movement to direction of light is this: the test tube with animals at one end, *a*, is put on the table with this end away from the window but in a strong beam of sunlight coming obliquely from the window to strike the test tube nearly at right angles. Now the animals are in the strong sunlight, but, directed as it seems, by the diffuse light coming from the other end of the tube, *b*, nearer the window, they all wander toward that end, *b*. Modifying this so that the end, *b*, is in the sunlight while the end, *a*, is away from the window and in diffuse light the animals still go toward the window though now leaving the lesser illumination for the more intense one.

To determine the action of light of various refrangibility the tube is covered by colored glass. Thus if blue glass cover the entire tube the animals act as if white light were used, but under red glass they react very slowly indeed. The same results are obtained with colored solutions instead of glass.

Covering one end of the tube, (either end) with blue glass produces no visible result other than that observed when white light was present all along the tube, but if red glass be used the animals move just as if the red region were the obscured, not illuminated region, of the first experiments. When the window end is covered by red and the room end by blue, the animals collect at the boundary between the two when the tube is perpendicular to the window, but when parallel to the window they distribute themselves all along the blue region.

It is thus the more strongly refrangible rays which are effective, the less refrangible rays having little influence.

A certain intensity of light is necessary in these experiments since in the evening the light gradually ceases to produce movements and artificial light may be intense enough to act like sunlight. Moreover

of two unequal lights the more intense is followed by caterpillars. In all the experiments the stimulus continues as long as the light remains unchanged: the caterpillars remain at the end of the tube though the other end may be open.

Other stimuli that might vitiate the result ascribed to light are to be mentioned under the titles of negative geotropism, contact and temperature. The first phenomena are those seen when the animals creep up a vertical surface, but this is overcome by the action of light as shown by illuminating the tube from below through a narrow slit in an opaque covering, then the animals overcome the negative geotropic tendency and move down towards the light.

The effects of contact stimuli are seen in the tendency of the caterpillars to collect on the convex edges and corners of solids—a tendency that controls their position upon the buds of trees as well as on the objects offered them in the laboratory.

A source of warmth is unlike a source of light in that the caterpillars move away from it: this is made evident from experiments upon the animals in opaque boxes when brought near a closed stove. The movements are, however, not in the line of direction of the heat rays.

These experiments in *Porthesia* have been repeated upon nearly 100 species of insects but with the same results, so that they will serve as type of the reaction of a positively heliotropic animal.

Certain special cases of interest remain to be discussed: first the old problem of the moth and the candle.

When *Sphinx euphorbiæ* or other nocturnal moths are kept in a glass box they fly towards the window side at dusk, or in the daytime if disturbed. When an artificial light and a window are at opposite sides of the room the moth goes to one or the other according to the intensity.

Here also it is shown that it is the blue and not red light which directs the flight. It seems that these nocturnal moths have periods of sleep followed by periods of greater sensitiveness to light—being sensitive in the night. This rhythm is moreover not easily disturbed for when kept several days in a dark box the moths still continue to be restless in the evening. During the period that they are heliotropic they agree with the *Porthesia* caterpillars in all respects.

Plant lice in the winged state exhibit strong positive heliotropic movements and are also negatively geotropic and forced to move away from heat just as are the larvæ of *Porthesia*.

The young however offer unexplained phenomena, in not reacting to light but having definite positions upon the stem and under sides of the leaves of plants that do not appear due to any of the above causes.

Ants however are not heliotropic in the winged state until the period of sexual excitement, when they swarm out for the nuptial flight. Such ants gave the same results in the laboratory experiments as did the caterpillars under the same circumstances.

The two sexes differ, however, in that the males continue to go towards the light when its intensity has become too slight to affect the female. The others seem not to be heliotropic at all, from the author's observations at least.

The ninth chapter is devoted to the phenomena exhibited by flies. The larvæ of *Musca vomitoria* were experimented upon, either in test tubes or directly upon the table, and yielded the same result regarding the directive influence of light, white and colored, with the important exception that the animals move away from and along the direction of the light, being in fact *negatively* heliotropic.

That this is true of the youngest larvæ at time of hatching is demonstrated by allowing eggs to hatch out upon plates blackened with soot: the young then leave traces of their lines of progress and these are away from the light. If two windows at right angles supply light, the direction of march is in the diagonal between the two lines of stimulation. When, however, the eggs hatch in darkness, the young crawl in all directions. Certain complications, however, arise in the course of young larvæ as they seem to have a peculiar tendency to arrange themselves with the ventral side turned toward the light, provided this is strong sunlight. Heat appears to exercise no definite directive influence, though the presence of food causes them to move towards it and there is also a strong contact stimulus evinced in the tendency the larvæ exhibit to crawl under foreign bodies—passing thus under plates of transparent glass where negative heliotropism cannot be cited as the cause of the movement.

Though the larvæ are thus negatively heliotropic the adult fly is positively heliotropic as can be seen by repeating the experiment applied to the plant lice. Here however the problem is often made more complex by the numerous other stimuli which may act upon the fly and more or less nullify the results of heliotropism.

Negative heliotropism is shown also in the larvæ of two beetles, *Tenebrio molitor* and *Melolontha vulgaris*, combined in the first case with the peculiar contact sensitiveness, stereotropism, that leads the larvæ to collect in the concave angles of a dark box.

Though Dr. Loeb's experiments have been for the most part made upon insects, yet he states that he has been able to demonstrate heliotropism identical with that of plants in frogs, white mice, *Gammarus locusta, Cuma rathkii,* slugs, planarians, earthworms, leeches, and other worms.

Apparently the experiments of Romanes upon echinoderms are entirely unknown to him.

In this connection two other contributions to the subject of animal heliotropism, both by Dr. Loeb, may be reviewed as extending the observed facts over a wider field.

Groom and Loeb[1] found by direct experiment upon the larvæ, nauplius, of a barnacle, that these animals swim towards or away from the light, following the direction of the light and not going towards the more intense light. Moreover, here as elsewhere, it is the more refrangible rays which are most potent.

The heliotropic movements are, however, not always positive or negative but are interchangeable in any one individual, so that after the larvae have been in the dark some time they are all positively heliotropic, but when exposed to the light and moving towards it for some time they become, some sooner than others, negatively heliotropic and swim away from the light, etc.

This alternation of effect in the action of light is then applied by the authors to the explanation of some of the diurnal changes in the position of pelagic organisms, their wandering to and from the surface of the sea.

In another paper[2] Loeb shows by experiment upon the large annelid *Spirographis spallanzanii* that here also the annelid turns towards the source of light, placing its body so that the axis of its somewhat umbrella shaped expansion of radiating branchial plumes coincides with the direction of light. Now as the animal is a sedentary annelid living in a stout leathery tube from which only the branchial and anterior end protrude, this tendency to point to the light is resisted by the elasticity of the tube.

The tube however is found to bend also, after some time, so as to incline one way or another according to the direction of light, and then remain permanently bent for months, in fact when the animal is removed the tube is still bent.

[1]Groom and Loeb: Der Heliotropismus der Larven von Balanus perforatus. Biolog. Centralblatt, X, pp. 160–177, 1890.

[2]Dr. J. Loeb: Weitere Untersuchungen über den Heliotropismus der Thiere. Bonn, 1890.

As a direct bending of the tube by mechanical force does not result in this permanent change of form the author seeks to explain the observed result by the suggestion that the animal, bending to one side, reconstructs or adds to the walls of the tube on that side and so forces it to maintain its new position.

Again in a Serpula which lives in an inelastic calcareous tube, experiment shows that by changing the direction of light the tube becomes also changed in its direction. Here, however, the process is a very slow one and results from the growth of the newly formed part of the tube in the direction in which the worm turns its branchiæ and head under the influence of light; the tube once formed does not bend.

The dependence of the arrangement of animal structures upon the direction of light is shown again in the case of a certain sertularian hydroid. When pieces of the stem are inserted upsidedown in sand the old lower end, now exposed to the light, sends out both new stems and new roots. The new stems, as they grow, take the direction of the light rays and so do the new roots, but the former grow towards the light the latter directly away from it; are then positively and negatively heliotropic respectively. Adventitious roots coming out from the inverted stem show again this same negative heliotropism.

In the light of these and other experiments upon the direct response of animals to stimulation by light, gravitation, contact, etc., the author here protests against the introduction of " instinct " and " will " in the explanation of such phenomena, relegating such expressions to the same category as " vital force."

To return to the main paper.

Another extension of heliotropic phenomena is made in the case of the movement of the pigmental processes of the outer cell-layer of the retina in man under the action of light. In this part of the subject the author has no new observations to record, though his explanation of the movements of orientations of eye and head as due to the above heliotropism is sufficiently novel. The twelfth chapter concludes this contribution to heliotropism. Here we find some new facts brought together with some of those observed upon insects to show that the movements of an animal when acted upon light depend upon its morphological structure. Thus in a bilaterally symmetrical animal the oral end is found to be more irritable than the aboral end, the dorsal and the ventral sides not equally irritable, while symmetrical points right and left of the median plane are equally irritable. Hence arises the tendency to move directly towards or away from the light

with the median plane in the line of light, and the peculiar tendency to place the ventral or dorsal side towards the light in some cases.

In an appendix certain interesting experiments upon geotropism in insects are communicated in addition to those mentioned in the part treating of heliotropism. That caterpillars and beetles, (Coccinella) rapidly ascend vertical sides of boxes and remain at rest at the top is ascribed to a negative geotropism; while the various positions taken up by cockroaches, butterflies, spiders, etc., when at rest is likewise an orientation with reference to gravitation, direct or indirect.

Most suggestive experiments in extension of this view in which it appears that insects in a centrifugal machine perform some of the compensating movements ascribed to the function of the semicircular canals in vertebrates can be only mentioned in passing as they lead too far from the main thesis. That the geotropism is not confined to insects is well shown by Loeb[1] in the case of certain sea cucumbers (*Cucumaria cucumis*) which ascend to the top of an aquarium even when the apparatus is so devised that there is no question of greater air supply etc., at the top.—E. A. Andrews, Feb. 12, 1892.

The Homologies of the Cranial Arches of the Reptilia.— The following paragraphs contain an abstract of a paper read before the U. S. National Academy of Science under the above title on April 19th, and published in the Transactions of the American Philosophical Society in May, 1892.

The paper recorded an analysis of the cranial characters of the genera of Reptilia discovered in Permian beds in North America by myself. Those especially studied are Pariotichus, Pantylus and Chilonyx, which belong to the Cotylosauria (Cope; Pariasauria Seeley); and Edaphosaurus, Clepsydrops and Naosaurus, members of the Pelycosauria (perhaps equal the Theriodonta of Owen); and Diopeus g. n., founded on *Clepsydrops leptocephalus* Cope. The Cotylosauria have the temporal fossæ overroofed, so that the skull has the general character of that of the Stegocephalous Batrachia, with which it also agrees in its segmentation, an agreement especially well marked in Chilonyx.

The hypothesis of Baur was tested in its application to the origin of the bars of the Reptilian skull. This hypothesis supposes that the bars have been derived from the Cotylosaurian roofed skull by perforation, a kind of natural trephining; the position of which has determined the position and constitution of the bars or remaining portions

[1]J. Loeb: Ueber Geotropismus dei Thiere. Arch. f. d. ges. Phys. xlix., 1891.

of the roof. The existence of the genera of Cotylosauria in America and South Africa (Pariasaurus Owen), in the Permian beds, gives probability to such a theory, and I selected the genus Pantylus which presents the most unmodified type, as serving best as a basis of comparison for other orders of Reptilia. The segments concerned are the postfrontal, postorbital and jugal in front; and the supramastoid, supratemporal, and zygomatic, as the posterior elements of the roof and its resultant arches. The name zygomatic was employed for the element often called quadratojugal; supratemporal for the so-called squamosal; and supramastoid for the mastoid of Cuvier, a name already given by Cuvier to a distinct region of the mammalian skull.

I showed that the modifications of the Cotylosaurian roof, fall into the following categories.

1. "Roof reduced at margins only." (Baur).

One arch remaining (postorbital-supratemporal) in reduced types; or none; *Testudinata.*

2. One perforation only; no marginal reduction.

Perforation superior, not interrupting postfronto-supramastoid connection; *Ichthyopterygia.*

Perforation superior, interrupting postfronto-supramastoid connection; *Pseudosuchia.*

Perforation inferior, not interrupting postfrontal or postorbital connections; *Pelycosauria.*

Perforation extensive, preserving only the jugal-zygomatic connection; *Sauropterygia.*

3. Two perforations; no marginal reduction.

Postfrontal supramastoid connection interrupted; *Rhynchocephalia.*

Postfrontal and postorbital elements fused; *Dinosauria.* *Crocodilia.* *Pterosauria.*

4. One foramen and inferior reduction by loss of zygomatic arch.

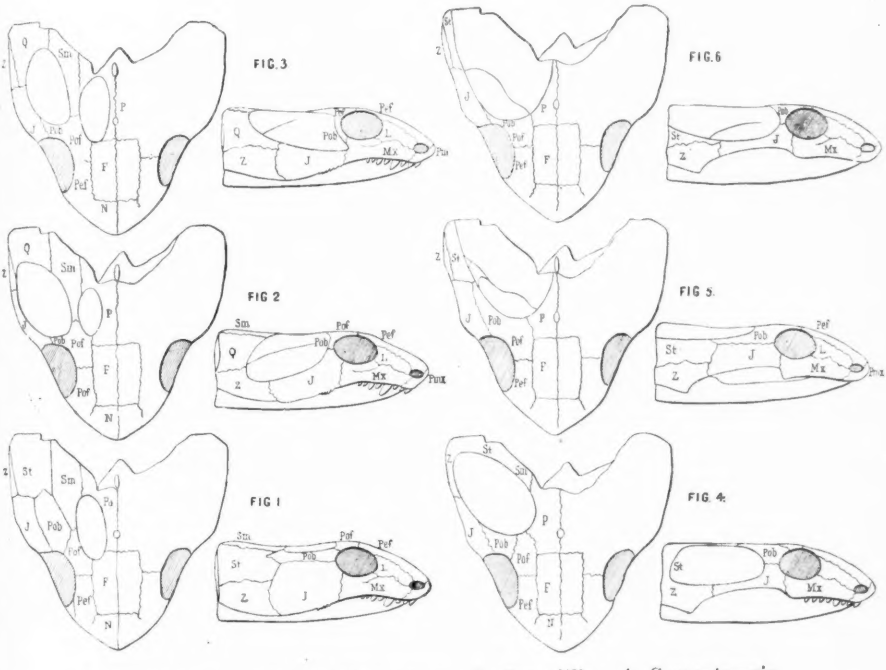
Quadrate bone fixed by suture; *Anomodontia.*

Quadrate not fixed by suture; *Squamata.*

The clearing up of the homologies of the arches is necessary to the correct understanding of the relations of the members of the Reptilia.

Five plates illustrate the memoir, of which three are here reproduced, copied from the Transactions of the American Philosophical Society.—E. D. Cope.

PLATE XVII.



1. *Ichthyopterygia.* 2. *Dinosauria.* 3. *Crocodilia.* 4. *Sauropterygia.*
5–6. *Testudinata.*

General Notes.

GEOLOGY AND PALEONTOLOGY.

The North American Coal Supply.[1]—General Wistar's discussion of the North American Coal Supply has been published by the Phila. Academy. The author first calculates the existing quantity of available coal in North America, the present and prospective rate of its consumption, its probable duration, and some of the physical consequences of its entire combustion. The figures and conclusions of the United States Census returns of 1889 have been followed, modified somewhat by the author's personal observations.

"The entire carboniferous area of the United States, excluding the broken Rocky Mountain territory is given at 219,080 square miles. A large proportion of this area, however, never did contain coal; and there are minor areas where more than two-thirds of the original beds have been carried away along with the adjacent protecting rocks and scattered far out on the sea bottom.

Again, much of the coal possesses no economical value because of its crushed and impaired condition, its detached position in small basins, and to the thinness of many beds. These reductions may be considered to offset the following items not considered in the Census report:

1. The detached basins in the Rocky Mountain territory.
2. The inaccessible coal of the arctic and tropical regions.
3. The relatively small beds of Nova Scotia and British Columbia.

Assuming then, the area, 219,080 square miles, as the area of mineable coal, the author discusses at length the data for calculating the average thickness and arrives at the conclusion that six feet is an admissable working estimate. This gives 219,080 square miles reduced to acres multiplied by 6 feet (of thickness) and by 800, being the available tonnage per foot of thickness from each acre, would give the tonnage, which is 673,013 millions of tons.

The same Census report states the consumption during the year 1889 at 126,097,779 tons, and the increase of consumption to have been at the rate of 100 per cent. per decade. From these figures the

[1]Remarks on the Quantity, Rate of Consumption, and Probable Duration of North American Coal, and the Consequence to Air-Breathing Animals of its entire Combustion. Proceeds. Phila. Acad., 1892, p. 82.

author calculates that the entire coal supply will be consumed at the end of 112 years from the year reported on, or say by A. D. 2001.

This is a fair deduction from facts which are known, and from reasonable estimates, the author calls attention to the importance of looking for some "power" or "force" to take the place of that generated by the combustion of coal when that supply shall be exhausted, as it undoubtedly will in little more than three generations. He maintains there is no intelligent ground for the expectation of the discovery of any new force, but suggests that physicists study more effective and cheaper methods of obtaining electrical energy.

The latter part of the paper is devoted to interesting speculations as to the effect of the increased amount of carbon dioxide in the atmosphere, resulting from the combustion of so much carbon, upon animal and vegetable life.

Cretacic Marine Currents in France.—At a recent meeting of the Académie des Sciences de Paris, M. Fouqué presented a note from M. Munier-Chalmas on the distribution and the direction of the marine currents in France during the upper Cretacic period. He shows the influence of the Alps upon the limitation to the South of that mountain system of certain molluscs and echinoids peculiar to southern regions, and gives an interesting picture of the vanishing from North to South, through the narrow Paris basin, of certain fossils peculiar to the northern seas: Micrasters, Belemnites, Rhynchonellas, etc.

This fact is analogous to what is now going on in the neighborhood of the Straits of Gibraltar. (Revue Scientifique, 9 April, 1892.)

Professor Marsh on Extinct Horses and Other Mammalia.[1]—In the American Journal of Science and Arts for April and May, 1892, appear two articles by Professor Marsh on the above subjects. As they are rather more than usually curious contributions to literature, they deserve early notice. The first cited is stated in the title to be "On Recent Polydactyle Horses," but it turns out to include a discussion of the extinct ancestors of the horse. This is preceded by descriptions of some remarkable examples of horses with supernumerary digits, one of which has rudiments of four in the anterior foot, a number unprecedented in the annals of polydactylism. The author then gives figures of the feet of the extinct horses, to

[1]On Recent Polydactyle Horses, Amer. Journ. Sci. Arts, 1892 April, p. 339.—A New Order of Extinct Eocene Mammalia, Amer. Journ. Sci. Arts, May, 1892, p. 445.

which he has applied the names Orohippus, Mesohippus and Miohippus, and shows what has been already suspected, that they do not differ from those described and figured many years previously as Hyracotherium for the first named, and Anchitherium for the second and third. He laments the tendency of naturalists to adhere to the appropriate names given by Professor Owen many years ago to the suborders Perissodactyla and Artiodactyla, and their failure to adopt his own names given to the same divisions, most unnecessarily, many years later. He then repeats as original some generalizations as to the origin of the line of the Perissodactyla, including the horses, which had been long previously made by others, and repeats a new name given to the extinct order Condylarthra, which was intended by him to express an anticipation of its future discovery. Unfortunately this prophecy had been made by others in 1873, and the discovery of the order had been already made and published (1881) before this prophecy of Professor Marsh's was uttered and the speculative name given (1885). He then goes on to state that the genus which first demonstrated the character of this ancestral type as foretold by Cope (1873), which is known as Phenacodus, is the American representative of Hyracotherium, and was previously named by him Helohyus. Professor Marsh evidently greatly mistakes the characters of Phenacodus, as that genus belongs to a distinct family and order from Hyracotherium. In spite of this assumption as to the ancestry of the horses, Professor Marsh contributes further to the confusion of his writings, by proposing a new name (Hippops) for the speculative ancestral horse. On the strength of his discovery (?) as to the true position of Helohyus, he proposes for it a new family of which it is the type, with a definition which in no way differs from that already given by other authors to the Hyracotheriine division of the family Lophiodontidæ,[1] and which excludes Phenacodus and all other Condylarthra from its limits. It is interesting to observe that Professor Marsh did not define the alleged genus Helohyus when he proposed it, and it is very curious that he does not do so now. He next defines for the first time his "Orohippidæ"; but the definition does not distinguish whatever it is supposed to embrace, from the before-mentioned "Helohyidæ," and we have further confirmation of the prevalent opinion that this name is also superfluous. On the next page definitions of the alleged genera Eohippus, Helohippus, Orohippus and Epihippus, are given for the first time, *i. e.* sixteen years after the names were proposed (except Helohippus, which is new). The names

[1]AMERICAN NATURALIST, 1887, 993. Perissodactyla.

should therefore bear date, 1892. The author shows that Eohippus is not as primitive a type as Systemodon, and that it is little, if at all, distinct from Hyracotherium. Helohippus he does not distinguish from Pliolophus Owen (1841). "Orohippus" is not distinguished from "Epihippus." He then fails to distinguish "Miohippus" from the long known Anchitherium, and correctly describes the characters of Protohippus as though he had discovered them, although they were made known by others seventeen years ago.

The article in the May number of the American Journal recites that Professor Marsh has "discovered" a new order of Ungulata which he calls the "Mesodactyla," which is established on a new genus which he terms "Hyracops." This genus is defined with the omission of essential details as to the structures of the upper and lower molars. It is said to resemble Meniscotherium, differing only in that the last premolars resemble the true molars. This definition is of very doubtful value, since in Meniscotherium the last inferior true molar is like a true molar, and the last deciduous superior molar, has the same peculiarity, and persists, as Marsh observes, a long time.[1] Professor Marsh gives us figures of the fore and hind feet of his specimen, which are very welcome, as the structure of the former has been hitherto unknown. These figures show that the reference of Meniscotherium to the order Condylarthra made in 1885 is correct. As to the name Mesodactyla, it will probably be adopted when the universally adopted Artiodactyla and Perissodactyla are put aside for the names Professor Marsh so strangely desires us to use in their place. The proposal of a new name is all the more remarkable since Professor Marsh had already proposed a new name (as recited in the first article here commented on) for the theoretical type which is actually represented in this foot structure, as anticipated by Cope in 1873, and actually discovered in 1881.[2] In his discussion of the affinities of this form, Marsh repeats well-known generalizations as new and especially one made by myself, which has not found general acceptance, viz: that this type (the Condylarthra) is ancestral to the Lemurine Quadrumana. This generalization is fully confirmed.—E. D. Cope.

On the Correlation of Moraines with Raised Beaches of Lake Erie.—During the field seasons of 1889, 1890 and 1891, Mr. Frank Leverett made a series of observations of the raised beaches

[1]Such a specimen is represented by Cope in the Tertiary Mammalia. Pl. xxvi, fig. 2, 1885.

[2]American Naturalist, 1881, p. 1017.

of Lake Erie, which are embodied in a paper published in the American Journal of Science, April, 1892. The results of the author's studies are summarized as follows:

"It appears that Lake Erie, in its earlier stages, was but a small body of water, its size being conditional by the position of the retreating ice-sheet and by the height of the Western rim of the basin it occupied. It at first occupied only a portion of the district between the outlet and the Western end of the present lake, the remainder of the basin, including the whole of the area of the present lake, being occupied by the ice-sheet. Its South and North shores were then at the Van Wert ridge, while its Eastern border was at the Blanchard moraine.

"By a recession of the ice-sheet Northeastward to about the meridian of Cleveland, the lake became much expanded and its level was lowered a few feet, though the outlet still continued down the Wabash. Its North and South shores then occupied the Leipsic beach, while on the East the wave still beat against the ice front. The ice-sheet itself seems to have broken into bergs at its margin, and to have formed no terminal moraine at that time, though its lateral moraine is well developed.

"A subsequent recession resulted in the lowering of the lake below the level of the Ft. Wayne outlet, probably by opening a passage to the Chicago outlet, for no other outlets were open to this lake at that time through the Huron and Michigan basins. The North and South shores of the lake were then occupying the Belmore beach, while the East shore was unrecorded because the waves beat against a vanishing sheet of ice, and the ice itself, as in the preceding stage seems to have failed to form a terminal moraine, though its lateral moraine is strong.

"From the phenomena attending the replacement of the three beaches in Ohio by moraines, we are led to suspect that two later beaches which die away in Southwestern New York are there connected with moraines, and that similar moraines will be found to connect with the beaches of Lake Ontario, at points were they disappear on its Eastern and Northern borders.

"Differential uplift was slight in the Western Erie basin compared with what it was in the Eastern Erie basin and the Ontario, in Michigan, and on the Canadian shores of Lake Huron and Georgian Bay. The data at hand indicate that it amounts to scarcely more than ten feet in the whole area of the portion of the Erie basin West of Cleve-

land, and has therefore played an insignificant part in causing the three stages of the lake herein described.

"The bulk of the moraines is many times that of the beach deposits, though no longer time was involved in their deposition. The ice-sheet was therefore a much more efficient transporting agency than the lake waves.

"The extreme scarcity of evidence of life in these waters, though negative in its nature, and therefore to be taken with caution, is quite accordant with the theory deduced from the relation of the beaches to the moraines, viz: that the beaches are of glacial age."

Glacial Movements.—Prince Roland Bonaparte has been carrying on some extensive researches on the advance and recession of the glaciers of the French Alps. His work is thus referred to by the *Revue Scientifique*, April 9, 1892.

In order to express in figures the extent of glacial movements, Prince Roland Bonaparte, in 1890, had a certain number of marks put at the foot of sixteen large glaciers of Pelvoux. Whenever it was possible he had made a detailed topographical plan of the front of the glacier which, at the same time, was photographed from a point carefully marked. These operations repeated each year will furnish, and have already furnished precise data as to the oscillations of the glaciers, they will some day, perhaps, show a connection between their movements and the general phenomena of the atmosphere. For the present, the results which he has obtained from sixteen glaciers, from 1 to 6 kilometers in length, show that during 1890 and 1891 several of them have ceased to recede and have become stationary, which indicates the close of a period of general recession which began about 35 years ago. But the period of forward movement in the glaciers of Pelvoux is quite recent, for the facts observed go to show that the first glaciers which have advanced commenced to do so within the last few years.

The exact measures taken by Prince Roland Bonaparte are supplemented by the observations made at his request by the guides of that region in 1891; these extend over twenty-eight other glaciers of Pelvoux and can be summed up as follows: Eight glaciers advancing, twenty glaciers receding, and ten glaciers stationary. Finally, in 1891, the author marked fifteen glaciers in Savoy, and twenty in the Pyrenees. In these two regions the greater part of the glaciers are still receding, but they are increasing at their source, which indicates a speedy change to an advance.

Geology of the Tonga Islands.—In the May number of the *Geological Magazine*, 1891, Mr. Alfred Harker makes the following statements concerning the Tonga Islands in the South Pacific Ocean:

"It is well known that most of the Pacific islands which have been explored seem to be built largely of either volcanic or calcareous formations, usually supposed to be of recent origin. Indeed, the idea seems to have been entertained in some quarters that such was the universal construction of the islands. Drasche, writing in 1879, restricted this theory to those islands lying eastward of a certain line, drawn from Kamschatka through Japan, the Philippines, New Guinea, New Caledonia, New Zealand, Auckland, and Macquarie Islands to the Antarctic Victoria. Even at that time, however, such rocks as clay-slates, graywackes, etc., had been recorded in the Chatham Islands and New Britain, east of Drasche's line, and leptinites, granite, and gneiss in the Marquesas, far to the East. Later researches have proved the existence of numerous crystalline rocks, igneous and metamorphic, in the larger islands of the Fiji and Solomon Archipelagos, and suggested that in many other islands such rocks may be only masked by a comparatively thin covering of organic or volcanic accumulations.

"It may be inquired, then, whether the Tonga Islands show any indication of the existence of denuded crystalline rocks beneath the newer deposits. No such rocks have been found in place, and the evidence available is very slight. Ena, the most Southerly of the larger islands, differs to some extent from the rest in geological structure, and from the Eastern shore of this island Mr. Lister collected a boulder, one of many seen there, which is neither a volcanic nor an organic rock. I have described it (*Geol. Mag.*, April, p. 172) as a uralitized gabbro, and, though some petrologists would prefer to name it diabase, it is unlike any superficially erupted lava. Further, there is no doubt that it is derived from the island on which it was found. The only other suggestive point is the rare presence of minute fragments of red garnet and blue tourmeline in the calcareous andesitic sandstones largely developed on the same island. These fragments, blown out from a volcano, point to the existence of metamorphic rocks below, though at what depth it would be idle to speculate.

"With the exception of Falcon Island rocks, all those examined from the Tonga Island appear to be of submarine formation. The absence or presence in different strata of any sensible proportion of calcareous matter and organic remains is perhaps related to the more or less rapid rate of accumulation at different epochs of eruption. The volcanic material ejected seems to have been almost exclusively of frag-

mental character, and in some cases there are indications of violent explosive action. This is quite in accord with the andesitic nature of materials thrown out, which are of types common in the Pacific region. As to the age of the rocks, it would be idle to speak until the evidence of their organic contents has been duly set forth; but it would undoubtedly be very rash to refer them all to a recent age, and some of them may be found to go back far into the Tertiary times."

Geological News—General.—Several fossils collected by M. Griesbach while exploring the Central Himalayas closely resemble those found in the corresponding Alpine beds. In view of this fact, the Academy of Sciences of Vienna has decided, by an agreement with the Indian Government upon an exploration of the Central Himalayan region in order to compare its geology with that of the Eastern Alps. M. Diener, president of the Alpine Club of Vienna, will take charge of the expedition. (*Revue Scientifique*, April, 1892.)

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—One of the most valuable contributions to American petrography that has yet appeared is that volume of the Arkansas Geological Survey Report that treats of the eruptive rocks of the State. In it the late Dr. J. F. Williams[2] gives an excellent account of the little-known but very interesting eleolite and leucite rocks that occur as bosses and dykes in Pulaski, Saline, Hotsprings, Garland and Montgomery Counties. It would be well worth the while to give a full abstract of the author's careful investigation of these extremely rare rock-types, but space allows merely a reference to the mere outline of his work. Especial importance is attached to the study of the eleolite syenites at the present time, particularly where its plutonic and dyke forms occur together, since Rosenbusch has recently prophesied the existence of a group of dyke forms which he calls monchiquites, that will be found to occupy a position among the eleolite rocks corresponding to that held by the camptonites, among the plagioclase rocks. The age of the Arkansas eruptives is probably late Cretaceous. In Pulaski County they form the main mass of Fourche Mountain. The most abundant variety here is that locally known as 'blue granite.' It is a granitic porphyritic rock in which the

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2]Ann. Rep. Geol. Surv. of Ark. for 1890, vol. ii, 457 pp.

phenocrysts are orthoclase, and the ground mass is a granular aggregate of cryptoperthite, arfvedsonite, diopside, biotite, eleolite and other accessory components. Arfvedsonite is the most prominent dark constituent, while eleolite among the lighter-colored components is scarcely more than an accessory. The rock thus resembles the augite-syenite, called laurvikite by Brögger[1], but it contains so much more hornblende that Williams decided to give it a new name, pulaskite. Analyses of the rock and its feldspar follow:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	MnO	K_2O	Na_2O	H_2O	P_2O_5
Rock.	60.03	20.76	4.01	.75	2.62	.80	tr.	5.48	5.96	.59	.07
Felds.	66.95	17.87	.90		.52	.24		7.82	5.20	.30	

A second rock, occurring along the base of the mountain and a short way up its sides in the form of sheets, is known as 'gray granite.' Its structure is trachytic granular, with large twinned microline-perthites, eleolite, biotite, diopside and aegirine in large quantities. The eleolite frequently changes into analcite. The rock, though quite acid, as the analysis shows, is nevertheless an eleolite syenite, closely similar to laurdalite.[2]

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O
59.70	18.85	4.85	1.34	.68	5.97	6.29	1.88

In and around the mountain are small dykes, filled with 'brown granite,' miarolitic eleolite-syenite and quartz syenite. The brown granite is an eleolite-syenite containing orthoclase, diopside, eleolite and biotite, but no amphibole. In chemical composition it is quite like nordmarkite,[3] but mineralogically it is very different. The miarolitic rocks are panidiomorphically granular. In the eleolite-syenite there is a tendency of the eleolite toward idiomorphic forms when it is not in large quantity. In the quartz syenites the quartz tends toward idiomorphism. An analysis of one of these rocks gave:

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	K_2O	Na_2O	H_2O
64.63	18.15	3.05	1.00	1.54	.50	4.79	5.80	1.08

Rocks, called by the author border rocks, presumably occurring on the peripheries of dykes and bosses of the eleolite-syenite, contain tabular

[1]Zeits. f. Kryst., xvi, p. 28.
[2]Ib. p. 33.
[3]Ib., xvi, p. 54.

phenocrysts of sanidine and also sodalite and eleolite in a fine-grained groundmass of eleolite, orthoclase and minute idiomorphic pyroxenes and amphiboles that sometimes shows a fluidal structure. Because of their porphyritic structure and their close relationship with the eleolite-syenite they are classed by the writer among the tinguaites.

The augitic rocks associated with the eleolite-syenites in this region are classed in Rosenbusch's new division of dyke rocks monchiquite. They are all dark in color, and all are characterized by the possession of phenocrysts of augite or of biotite. Those containing olivine are placed with monchiquite, while of the non-olivinitic varieties two new groups are formed; one, called fourchite, possesses phenocrysts of augite; in the other, ouachitite, biotite occurs in large quantity. In the former augite constitutes nearly 75% of the entire rock. Its ground mass is now crystalline, but its structure is thought to be the result of the devitrification of a glassy base. In the amphibole ouachitites the phenocrysts are biotite, hornblende and a few augites in a fine-grained but originally a glassy groundmass. Augite is still the most prominent bisilicate, but it now constitutes scarcely 20% of the rock mass. The groundmass is composed of minute hornblende and augite crystals, with much magnetite and small, highly refractive grains of what the author supposed to be sphene. The base contains many small, lath-shaped crystals of feldspar. In addition to these two members of the monchiquite group, there is probably a true monchiquite at the south end of Allis Mt., in the same district. This rock is remarkable for its great number of sphene grains and for the common occurrence in it of pseudomorphs of biotite after augite.

At a few places where the contact of the syenite with the surrounding shales may be studied, the latter are found to be much changed and to have developed in them small, irregularly bounded feldspars, a few flakes of biotite, grains of magnetite and plates of hematite.

The sequence of the eruptives is believed to be as follows: Eleolite-syenite and pulaskite (same magma), fourchite, pegmatite and miarolitic dykes.

In the Saline County region the rocks are not very different from those of Fourche Mt. The prevailing gray syenite is coarser in grain than that of Fourche Mt., and its orthoclase crystals (intergrown with albite) tend to become porphyritic. The eleolite is also sometimes in large crystals. A plagioclastic variety of the same rock is slightly more granitic than the orthoclase variety. The pyroxene is aegirite instead of diopside. Pulaskite is absent from this region, but in its place occurs a porphyritic syenite with large orthoclase crystals, crys-

tals of arfvedsonite, biotite and an occasional diopside, imbedded in a fine-grained mosaic of orthoclase and amphibole. This rock also contains spheroidal masses of orthoclase crystals that may be pseudomorphs after leucite. The dyke rocks cutting the eleolite-syenite are grouped into eleolite-syenite pegmatites, aegirite tinguaites and eleolite porphyries. The tinguites are non-eleolitic, while the eleolite porphyries contain large rounded eleolites and aegirites enclosed in a fluidal mass of needles of the last-named mineral. The augitic dykes are much more common in this region than elsewhere. They belong to the monchiquites and the amphibole varieties of this rock. The ground mass of the latter consists of a transparent mass, partly isotropic and partly doubly refracting, in consequence of the development in it of plagioclase and orthoclase laths. Contact rocks are rare, but in one idiomorphic crystals of astrophyllite and aegirine were observed.

The Magnet Cove region is especially interesting, not only because of the fine minerals that occur there, but also because of the great variety of rare rocks found in the neighborhood in great quantity. It is to these latter that the minerals owe their origin. Of the eleolite-syenite occurring here three types are distinguished. One is an eleolite mica syenite, a coarse-grained rock in which eleolite has almost completely replaced orthoclase as the alkaline component. Eleolites, apatites, schorlomites and protovermiculites measuring as much as eight inches in diameter are frequently found imbedded in the decomposed rock. The principal constituents of the fresh rock are allotriomorphic eleolite, biotite crystals, idiomorphic zonal melanites, allotriomorphic schorlomites and large round masses of the same mineral, diopside, crystals of sphene, of ilmenite and of magnetite (the latter giving rise to the lodestone from which the Cove takes its name), pyrite and apatite in large crystals and in needles radiately grouped. Besides these there are also found in the decomposed rock ozarkite, protovermiculite, cancrinite and calcite. The second variety of the syenite is an eleolite garnet syenite made up of a granular mixture of eleolite, melanite and diopside, with small quantities of biotite and the usual accessories. The third type is a miarolitic variety too much weathered to yield good sections. Of the eleolitic dyke rocks one is hypidiomorphically granular, with a tendency to the trachytic structure. It contains a large quantity of orthoclase, eleolite in idiomorphic and allotriomorphic grains, large idiomorphic crystals of aegirine, cancrinite that appears to be in part primary, several other accessories and a number of secondary substances, among which may be mentioned aegirine, fluorite and calcite. A pegmatitic dyke consists of huge microline crystals,

beautiful crystals of aegirine, eleolite, eudialite, and other decomposition products of eleolite. This rock is the gangue of many of the sphene, natrolite, brucite, manganopectolite and eucolite crystals obtained in this region. Other dykes in which eleolite occurs in two generations, sometimes with and sometimes without orthoclase in the ground mass, and an eleolite tinguite, in which the phenocrysts are orthoclase are also described. But perhaps the most interesting of the rocks of Magnet Cove are the leucite dyke rocks. Of these the author distinguisues between leucite-syenite and leucite-tinguaite. The former is a hypidiomorphic granular aggregate of a pseudomorph after leucite, eleolite, orthoclase and the basic silicates, diopside and biotite. It is generally connected with eleolite-syenite, and is easily recognized by the large crystals of pseudo-leucite scattered through it. These are imbedded in a ground mass in which may be detected eleolite, black garnets and feldspar. No trace of leucite may be discovered in the large crystals. They are now composed of tabular orthoclases, interspersed with small eleolites and pyroxenes. Within the mass the orthoclase is radial, while on its periphery small tabular crystals have their symmetry planes perpendicular to its surfaces. The ground mass has the structure of an eleolite porphyry. The tinguite occurring as dykes possesses two generations of orthoclase, aegirine, eleolite and the pseudomorphs of leucite, besides many accessory components. It differs from the eleolite-tinguite mainly in the possession of orthoclase in large quantity. Analyses of eleolite-tinguite, leucite-syenite, tinguite and of the pseudo-leucites follow:

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	SrO	MnO	MgO	K_2O	Na_2O	Cl	P_2O_5	Loss
Ele-Tin.........	53.76		23.21	1.27	3.18	2.94	.04		.23	7.01	6.97	.02	tr.	1.71
Leu.Sye......[1]	50.96	.52	19.67	7.76		4.38		tr.	.36	6.77	7.67			1.38
Leu-Tin......[2]	52.91		19.49	4.78	2.05	2.47	.09	.44	.29	7.88	7.13	.53	tr.	1.19
Pseudo-Leu..	55.06		25.26			.60	tr.		.28	10.34	7.60			1.78

On the contact of the eruptives with the country rock hornstones are formed, but these are so indefinite in their character that but little could be learned from their microscopic study. In the sandstones and limestones through which the eleolite-syenite cuts there are, however, important contact minerals, many of which are of world-wide interest. Among those found in quartz rock and sandstone may be mentioned smoky and milky quartz, arkansite, rutile and hematite. The lime-

[1]The leucite-syenite contains .54% of NaCl in addition to the sodium given above, besides a trace of SO_3, and the leucite-tinguaite[2] .52% of SO_3 and .48% of insoluble oxides.

stone gave rise to perofskite, magnetite, apatite, phlogopite, vesuvianite and monticellite.

In the potash Sulphur Springs region the eleolite and augite rocks are but little different from those of Magnet Cove. The shale in contact with one of the eleolite-syenite dykes, however, differs somewhat from the contact rocks of other regions. Close to the eruptive the shale has a glassy appearance, and is cut by sheets and masses of pink and white minerals and bands of coarse crystalline calcite. Under the microscope sections are seen to consist of plagioclase, wollastonite, apatite and pyroxene in small interlocking crystals. The white masses cutting it are wollastonite, while the pink ones are xonotlite (hydrated wollastonite), in which a tenth of the CaO has been replaced by Na_2O. The author calls the variety natroxontolite.

Outside of the regions above mentioned aegirite-tinguite dykes occur at Hot Springs and at Hominy Hill, in Sec. 27, T. 1 N. R. 14 W.

The basic dykes outside of the syenite areas have been studied by Kemp, whose report comprises the twelfth chapter of the book under review. Most of them are narrow. In composition they are so closely related to the rocks already mentioned in this abstract that they are regarded as genetically connected with them. The most interesting of the dyke masses are the ouachitites. These are dark in color, and are all porphyritic, with very large phenocrysts of biotite and augite. The groundmass in which these are imbedded is composed of augite, magnetite and glass. An analysis of one of these rocks yielded:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	CO_2	P_2O_5	Tot.
36.40	.42	12.94	8.27	4.59	14.46	11.44	3.01	.97	2.36	3.94	1.04=	99.84

This rock, which is so very basic, is a constant associate of the more acid eleolite-syenite. All the basic dykes that have thus far been discovered in the State are mentioned in a table containing 280 entries.

In conclusion the author recapitulates his classification as follows: The eleolite plutonic rocks are called eleolite-syenites. From these are sharply separated the dyke forms, mentioned under eleolite-syenite dyke rocks, which are not porphyritic, but in the variety pulaskite (hornblende eleolite-syenite) are trachytic; the eleolite porphyries, in which eleolite phenocrysts occur; and the tinguites, characterized by porphyritic crystals of orthoclase. Among the latter are the eleolite, leucite and aegirite varieties.

Miscellaneous.—NEW BOOKS, ETC.—Mr. Lane[1] has recently published two tables for the use of students in optical mineralogy and petrography. One is devoted to the rock forming minerals. These are divided into three classes, the opaque, the isotropic and the anisotropic groups, and the members of the latter class are subdivided in accordance with the strength of their double refraction, their habit and the character of their extinction. There is no doubt but that with a little practice the student may easily learn to distinguish between the various minerals found in rocks if he will only follow the scheme carefully after reading the explanation accompanying it. In the second table the author gives an excellent resumé of Rosenbusch's classification of massive rocks, as elaborated in his 'Massige Gesteine.'——An even more recent tabulation of igneous rocks is that of Dr. Adams[2], since it reflects Rosenbusch's present attitude with respect to rock classification. In it the author represents in a very concise and simple form the differences between the various types of massive rocks, and suggests at a glance their relationships. In each of three horizontal columns are placed the plutonic, dyke and volcanic rocks in such a way that the corresponding members of all classes fall in vertical columns. The novel features of the classification are the following: Leucite-syenite is made a sub-group under the eleolite-syenites, and the tinguaites are represented as their corresponding granitic dyke forms. The rocks in which leucite, nepheline and melilite replace feldspar are given columns between the orthoclase and plagioclase rocks, as better indicating their chemical affinities than is the case when they are placed beyond the plagioclastic rocks. Each of the three groups is divided in accordance with the presence or absence of olivine, and in the niche for the plutonic nepheline combination is placed the new type iolite, recently described by Ramsay[3]. The lamprophyric dyke melilite rock is alnoite. Among the lamprophyric plagioclase nepheline rocks are fourchite and monchiquite, the latter with and the former without olivine. Malchite is a new rock described by Osann. It is the granitic dyke form of diorite. The diabases are put in the paleovolcanic class, which, by the way, is not sharply defined from the neovolcanic class. The basic non-feldspathic rocks are separated into the pyroxenites and the peridotites, which names sufficiently define themselves. Dr. Adams deserves the thanks of all petrographers for

[1]Am. Geol., June, 1891, p. 341.

[2]Can. Rec. of Sci., Dec., 1891, p. 463.

[3]Cf. AMERICAN NATURALIST, 1892, p. 334. By mistake iolite occurs in the wrong column in the table.

his enterprise in the preparation of this, the only modern classification of massive rocks published.——INSTRUMENTS.—Salomon[1] describes a simple piece of apparatus by means of which the density of a heavy liquid may be rapidly determined without the inconvenience of the use of a Mohr's balance. It consists essentially of a W-shaped graduated tube, whose manipulation depends upon the principle that the heights of the liquid columns in its two arms will vary with their differences in density. By the aid of the instrument the specific gravity of each mineral in a rock powder may be determined without once emptying it of its solution.——Four new microscopes for crystallographic and petrographical purposes have lately been introduced to the favor of investigators. The three[2] from the manufactory of Zeiss in Jena present no peculiar features. The fourth was made by Nachet to the order of Wyrouboff[3], especially for observations at high temperatures. The objective is below the object, and the nicol prism and the illuminating mirror are above it. The stage is fixed, while the microscope body revolves. Attempts to use converged light with this instrument have failed, because of the great heat to which the condensers are subjected.

[1]Neues. Jahrb. f. Min., etc., 1891, ii, p. 214.
[2]Czapski, Neues. Jahrb. f. Min., etc., B B. vii, p. 497.
[3]Bull. Soc. Franc., d. Min. xiv., 1891, p. 198.

BOTANY.

New Studies in Fecundation.—M. Leon Guignard publishes a paper in the[1] *Annales des Sciences Naturelles*, entitled "New Studies of Fecundation, with a comparison of the morphological phenomena observed in plants and in animals."

He reminds us that until very recently the essence of fecundation was supposed to reside exclusively in the union of two nuclei of different sexual origin, and that the protoplasm played but an accessory part in the process; that in phenogamous plants, for instance, the male nucleus penetrates alone the oosphere to the exclusion of its accompanying protoplasm. His recent observations, however, and the discovery of certain new bodies, new at least in vegetable cells, which he calls "directive spheres" and which play their part in the process throw quite a new light upon the subject and moreover bring into close accord the phenomena as existing in the two kingdoms. He follows the development of the reproductive elements, male and female, from the very beginning to their adult stage so as to determine the mode of differentiation by which they acquire sexual characters and then further follows these sexual elements, showing which are the essentially active parts, and how the union between them takes place to form the first embryonic cell.

The account which he gives of the technique employed in his researches is far from satisfactory; indeed he says himself that the "technique applicable to the study of vegetable protoplasm leaves much to be desired." As fixative agents he used absolute alcohol, corrosive sublimate, picric acid and osmic acid; to stain the protoplasm and the spheres he hardened the specimen in absolute alcohol and then in 10 per cent. solution of zinc sulphate or ammonia alum, followed by hæmatoxylin. Fuchsine and methyl green proved also of special value in distinguishing the plasmic contents of the cells.

He first describes the formation of the reproductive cells, the pollen grains and the embryo sac, using as his subject a species of lily, *Lilium martagon.* He traces each step in clear language and by the aid of beautiful figures, from the undifferentiated meristem of the budding anther to the archesporia or pollen mother-cells, to the special mother-cells and the mature pollen grains; and with the same nicety, the origin of the embryo sac with the egg apparatus (oosphere

[1]Ann. Sci. Nat.; Bot. Tome XIV. pp. 163–288. Plates 9 to 18.

and synergidæ), the antipodal cells and the secondary nucleus. In all this there is nothing essentially different to what may be found in the better text-books. But at a certain point in the development of the pollen, he shows us cells in stages of karyokinesis having each just twenty-four chromatic rods, each rod with its parallel halves stuck together throughout their length but destined to separate and form parts of the two new nuclei. In subsequent figures are shown the well formed anthers, the completed pollen sac and the special mother-cells. Upon the completion of the tapetal layer the primary mother-cells cease to divide and become the special mother-cells which now increase in size, become filled with protoplasm, each with a large nucleus and several nucleoli and closely appressed to the nuclear membrane, the two directive spheres lying side by side. Within the nucleus is a band of chromatin which may be likened to a tangle of endless narrow ribbons. In the last division by which these cells were formed the nuclei still showed the twenty-four rods of chromatin. There now follows a resting stage preparatory to forming the pollen grains. As the nucleus is to enter into activity its chromatic frame-work (charpente) may at least in part be traced out along its very sinuous course but without discovering any free ends within the nuclear cavity or any evidence of its being aught than a continuous endless filament; which means that the twenty-four rods must have fused end to end in its formation. A little later are to be seen twelve segments, each formed of two series of chromatin granules, free in the nuclear fluid. The halves of these rods are exactly the same in length and are united by a common hyaloplasm and from their ends also are still projecting fine delicate threads of the same plasma. The directive spheres now take their place as poles, the rods are carried to the equator and the spindle is soon completed. The halves of the rods now separate, that is, the ends directed towards the center or axis of the spindle, part first and the segments on their way back to the poles assume the forms of the letters U or V. The two nuclei thus formed at once enter again into division and the four pollen grains are perfected.

With each nuclear division the "directive spheres" have doubled, so that each new nucleus is provided with two spheres.

For the formation of the generative or sexual nucleus proper, the pollen nucleus divides to form a vegetative and generative nucleus.[1] Within the pollen tube the generative nucleus undergoes a second division, the spheres likewise doubling, and, as the plane of division is

[1]By the artificial culture of pollen the generative nucleus sometimes quite escapes from the pollen tube and offers a most favorable view of the directive spheres.

transverse to the length of the tube, the two new nuclei are so placed that the lower one is preceded, and the upper one followed, by its two spheres. Both of these nuclei are accompanied by their protoplasm and each has been seen to have its twelve chromatin rods. If the vegetative nucleus has not already disappeared, it may be distinguished from the sexual elements by the difference in reaction to methyl green and fuchsine.

The steps by which the differentiation of the female factor arises may be rapidly sketched as follows: A large cell in the axial row of the nucellus is the mother-cell of the embryo-sac. In all the cell divisions of the nucellus up to the moment when one of the cells becomes conspicuously larger and ceases to undergo further division the nuclei have all shown twenty-four chromatin rods. The embryo-sac grows rapidly so as to come to occupy a large part of the nucellus, sometimes descending towards the center of the same. Its nucleus contains one or more large nucleoli in the meshes of the tangled ribbon made up of two series of chromatin granules. The two directive spheres lie in contact with the nuclear membrane and the cytoplasm is now seen radiating without regard to the position of these spheres. The ribbon now breaks into rods and the substance of the nucleoli so changes as no longer to be distinguishable from that of the chromatin segments, the number of which is now twelve not twenty-four. The spheres become active, go to the poles and are surrounded by cytoplasmic rays. At first the rods are scattered in a disorderly manner through the forming spindle, but are soon carried and properly oriented by the achromatic threads about the equator so that there may now be seen a rod to each large thread, there being however some more delicate intermediate threads to which no rods are attached. Thus is formed the spindle and disk. The rods are easily seen to consist of longitudinal halves and in the further change they split at the ends directed towards the spindle axis, one-half appearing to glide up a thread towards one pole, the other half moving down towards the opposite pole until they finally part and become new groups of twelve contorted segments, shaping themselves into two new nuclei. The centrosomes in the meantime have doubled, forming two spheres at each end of the old nuclear axis. The new nuclei so formed appear in all respects quite similar and they move to opposite ends of the embryo-sac. The lower one especially gains in size, and both continue to divide. But in the next division the lower one is seen to have not twelve, but sixteen or twenty rods, whilst the upper one and its derivatives still have but twelve. There are now four cells or nuclei above

and four below; two synergidæ, the oosphere and a polar cell above, three antipodal cells and a polar cell below. As the oosphere has but twelve rods, the two sexual cells have thus the same number of these elements. The upper polar nucleus becomes larger than its brother nucleus of the oosphere. The lower polar nucleus moves round a large vacuole and joins the upper one of the same name, while the antipodal cells disappear. The spheres of the synergidæ are situated right and left, because in the division by which they were formed the spindle axis was horizontal; whilst the spheres of the oosphere and upper polar nucleus are in couplets above and below these nuclei because the spindle was vertical. This position of the spheres is of importance in the act of copulation, for the first step in this process is the meeting of the two spheres from each copulating nucleus and as the male nucleus is moving down the pollen tube with its two spheres head on, so the oosphere must so present its spheres as to squarely meet them; and to the same end the spheres of the approaching polar nuclei are most conveniently situated.

The approach of the sexual nuclei is as follow: The vegetative nucleus has disappeared while going along the pollen tube. The tube becomes narrow and insinuates its end between the epidermic cells of the nucellus. Arrived at the summit of the sac it enlarges into a flask-shaped extremity and pushes the membrane of the sac before it as it continues to advance inward either in a straight course or obliquely, without however spreading out its end upon the sac as is the case in *Monotropa* and in *Orchis latifolia*. From this time the membrane of the sac and of the tube are not to be distinguished. The tube enters by the side of the synergidæ or directly into one of them, in which latter case the contents of the synergidæ assume the peculiar appearance of disorganization. Strasburger thought that this was the rule and that the office of the synergidæ was to transmit the contents of the pollen tube to the oosphere. Whatever be the method of penetration, the male nucleus which arrives first in contact with the embryo-sac passes through the membrane and rapidly joins the nucleus of the oosphere. Strasburger now thinks that the liquid which directs this amorous flight of the male to the female nucleus is furnished by the synergidæ, playing the part which is attributed to malic acid and malates in directing the course of the antherozoids in the cryptogams. Guignard believes that this attraction may reside simply in the protoplasm of the female cell.

The male nucleus, as has been shown, is preceded by its two spheres which lie side by side and which are thus brought face to face with the

spheres of the female nucleus which they quickly join and so form two new couplets of spheres, each couplet containing a sphere of two different elements. This conjunction of the spheres takes place before the nuclei unite, but they do not fuse until the division of the nucleus begins. While still as couplets they take their position above and below, marking out the axis of the coming spindle, which is that of the long axis of the oospore. The second male nucleus sometimes escapes from and sometimes remains in the pollen tube and ultimately disappears in the protoplasm. The reason for the existence of two male nuclei is in doubt. That the division of the single primary one into the two smaller masses is so that the male and female nuclei may be nearly in equilibrum as to size, is not a satisfactory suggestion; and since the two male nuclei are equally active and effective in fertilization, the division of the primitive nucleus could not have been a matter of differentiation. After a long contact of the male and female nuclei, the nuclear membranes at the surface of contact disappear and the contents form a common mass; that is, the nuclear fluids mingle, but there is not a true fusion of the chromatic elements. Contraction and orientation of these elements follow with the formation of a spindle and nuclear disk, and a return to twenty-four rods. Twelve of these may have been furnished by each nucleus but they are not to be distinguished from one another. The two groups of secondary segments collect at the poles, a wall of cellulose is formed at the equator and two embryonic cells come into existence. Thus fecundation has resulted in doubling the number of rods in the first segmenting nucleus.

It happens with curious constancy that the secondary nucleus of the embryo-sac begins its division for the formation of endosperm, just at the time that the male nucleus penetrates the oosphere. This secondary nucleus formed by the union of the two polar nuclei, which were larger and rich in chromatin, contains a greater number of rods, as do its derivatives, than are to be found in the egg nucleus. So likewise do all the nuclei of the endosperm contain a greater number of rods than do the nuclei of the rest of the ovule and other organs of the plant. This variation in the number of rods opposes the idea of the chromatic segments retaining their individuality during the resting stage of the nucleus. In *Leuconium* and in *Galanthus*, as the embryo-sac becomes somewhat crowded with nuclei and their spheres, and as cell walls arise, there may be included as many as ten or twelve nuclei in a single cell. Under these conditions the spheres act upon closely neighboring nuclei in such a manner as to form multipolar spindles. Such figures have lately been seen by Henneguy in the parablast of

the trout, a tissue comparable to the endosperm, and also in epithelial tumors. From such multipolar figures more than one daughter nucleus may naturally be expected to be formed.

Most of these observations have been taken from the lily. Other plants show differences of more or less moment; thus, it is found that the number of chromatin rods, so constant in the sexual cells for the species, may yet vary in members of the same family.

Guignard's work was awarded the Bordin prize by the Academy of Sciences of Paris. The title of the subject given for contest required an exposition of the relations which exist between the phenomena attending fecundation in the vegetable kingdom, with those observed in the animal kingdom. This obliged him to summarize the work done by zoologists in this field, and there follow at this point some twenty pages devoted to the consideration of the sexual cells in animals, the polar globules (richtungskörper), their homologies with the spermatozoids and their general morphological value. In all this he rests upon the contributions of Lowen, the Hertwigs, Fol, Van Beneden, Boveri, Weismann, Ischikawa, Blochman, Bütschli, Whitman and others. The judges, as we learn from another source, say that this part of the work was done with skill and conscientious care. From Guignard himself we get the impression of the strict analogy of the processes of fecundation as they occur in the two kingdoms. Under the heading "General Exposition of Results" the author retraces the subject matter already given: the fixity or constancy of the chromatic rods as to number in the sexual cells; the appearance of and the mode of reduction in the number of these rods at a given stage; the constitution of the nuclei, including a discussion of the individuality of the chromosomes; the existence of "directive spheres" in all vegetable cells; the role or function of these spheres which are distinctive organs of the cells and, lastly, a review of the prevailing theories concerning the phenomena of fecundation. Of this he says, "We see that fecundation is not only a conjugation of nuclei, but accompanying this act is that of the fusion of two protoplasmic bodies whose essential elements are represented in the directive spheres of the male and female cells."

While hovering so closely about the subject of heredity it was not to be expected that it should go untouched. After noticing the theories of several prominent workers in this direction he gives in a single paragraph the gist of his own views by saying, "That all the cells, or at least, a greater part of the cells of the body possess in a latent condition all the hereditary properties of the species. A little bit of the

body can reproduce the entire organism. A branch of willow placed in water develops roots at the expense of cells, which thus come to play a part quite different to what was laid out for them in the original plant, a proof, that is, that they already possessed this property from their conception. On the other hand, a severed root may give rise to buds which bear male and female organs; so that sexual cells may be derived directly from the cellular substance of a root. The epidermic cells of a Begonia may produce an entirely new plant just as with cœlenterates, worms and tunicates, new individuals may come from buds or separate parts of the body of these animals. These facts are trite enough," he adds, "but it is well to recall them to show the solid basis of Hertwig's conclusion that, 'the nucleus, by reason of the phenomena it presents during fecundation, is the support or conservator of hereditary properties and that it reappears in the same form and with the same properties in every cell; that it is a substance removed from the grosser metamorphoses of matter by its inclusion in a special vesicle; that by a complex mode of division the daughter nuclei receive portions of the same substance, no differentiation having arisen. Just as Nägeli claims that his hypothetical idioplasm is spread throughout the body like a fine net-work, so according to my theory, every cell of the body encloses in its nucleus the aggregation of hereditary properties derived from the egg, whilst the specific properties of the cell are bound up with the development of the protoplasmic products, consequently every cell possesses the faculty, under appropriate conditions of reproducing the entire organism.'"—B. W. Barton, M. D., Johns Hopkins University, Baltimore, Md.

ZOOLOGY.

The Limpet's Strength.—The experiments made by J. Lawrence-Hamilton show that the shell-less limpet pulls 1984 times in the air its own weight, and about double when immersed in water.

Fasting fleas on an average pull 1493 times their own dead weight.

Other experimenters give the pulling power of the shell-deprived *Venus verrucosa* of the Mediterranean, a cockle-like creature, at 2071 times the weight of its own body.

The force required to open an oyster appears to be 1319.5 times the weight of the shell-less oyster. (Nature, March 24, 1892).

Dr. Steindachner has published the 15th part of his Ichthyologische Beiträge[1] in which he describes the following species of South American fresh-water fishes.

Piabuca argentinia Lin.; Iquitos.

Piabuca spilurus Günther; Hyavary.

Bergia n. g. near *Chalcinus*; no canines behind median teeth in lower jaw; lateral line median.

Bergia altipinnis sp. nov.; Arroyo Mignelete near Motevideo.

Tetragonopterus lineatus sp. nov. Iquitos.

Tetragonopterus anomalus sp. nov. Rio Parana near Corrientes.

Xiphorhamphus jenynsii Günther; Arroyo Miquelete and Parahyba.

Xiphorhamphus hepsetus Cuv.; Arroyo Miquelete and Parahyba.

Medical and Other Opinions upon the Poisonous Nature of the Bite of the Heloderma.—In North America there are two species of Heloderms,—the *Heloderma horridum* of Wiegmann, a form that does not occur within the limits of the United States, and the *Heloderma suspectum* of Cope, which is found principally in suitable localities throughout Arizona. There this, the biggest by all odds of all our lizards, is popularly known as the "Gila monster," from the fact that it was once common on the Gila River. Collectors are now rendering it scarce over nearly all its range, and no doubt the time is not far distant, comparatively, when this highly interesting species will meet with utter extinction.

Living specimens of this reptile have been in the writer's possession for a year or two together, affording him admirable opportunities to

[1]Sb. Ak. Wiss. Wien, 1891.

study it in all particulars,—advantages I have fully availed myself of, as my published papers on the subject will attest.

Adult Heloderms average some twenty inches in length, and are covered with tuberculated scales, which vary in form in different parts of the body, and in old specimens are prone to ossify over the back and top of the head. These scales are of a shiny black and orange, the two colors being arranged in a definite pattern, which latter never agrees in any two specimens. Nothwithstanding this great size for a lizard, and this most striking coloration, there are many people in Arizona and in the southwest generally that apply the name "Gila monster" to any large lizard-looking form that may come under their observation. I have had medical officers in the army, ranchmen, guides, and others, who surely ought to know better, point me out Amblystomæ, and even the common forms of the Phrynosoma, as Gila monsters. This being the case, I feel quite sure that the excellent figures which I have offered of a large female Heloderm that I had, some time ago, alive for nearly two years, will be acceptable, and in some respects exceedingly useful,—useful because the general opinion in the southwest and elsewhere is that the bite of this saurian is poisonous, and as a matter of diagnosis it is very desirable to know that the patient has actually been bitten by a Heloderm and not by something else.

Fig. 2 is from an instantaneous picture where I strapped my camera in such a position as to bring the focal axis of the lens perpendicular to the floor, where I placed a sheet of white blotting paper, over which the reptile walked beneath the instrument, allowing me to secure the photograph. In Figs. 1 and 3 the Heloderm was hypnotized, and thus easily taken. In Fig. 1 the ventral aspect of her head and body is resting upon a plane surface, which gives a flattened appearance, but otherwise the likeness is admirable. The leading herpetologist in this country, Professor Cope, who was my guest this week, examined these photographs and remarked that they gave a better idea of the form of a Heloderm than any of the many figures that had thus far been published, either here or in Europe.

We now come to consider that part of the subject that falls more properly within the title of this contribution,—in other words, the nature of the bite of these reptiles.

Even at the present writing the wide variance of opinion in these premises is truly remarkable, for some of our most distinguished investigators still disagree in the matter, and those, too, who have made the most exhaustive examinations of the saliva of this reptile.

As long ago as 1857, John Edward Gray, of the British Museum, in referring to Necturus, said: "I know of no other instance of a batrachian having this structure of its teeth, nor do I know of any instance, except in the Mexican lizard called *Heloderma horridum*, in which *all the teeth* are uniformly furnished with a basal cavity and foramen, and this lizard is said to be noxious; but the fact has not been distinctly proved."

Professor E. D. Cope, who first clearly characterized this reptile, and gave it its present name of *Heloderma suspectum*, has stated that "though the lizards of this genus could not be proved to inflict a poisonous bite, yet the salivary glands of the lower jaw were emptied by an efferent duct which issued at the base of each tooth, and in such a way that the saliva would be conveyed into the wound by the deep groove of the crown."

Then several years passed before much else was published upon this special topic of the life-history of the Heloderma, when Sumichrast, a well-known naturalist resident in Mexico, stated it as his opinion that it was the exception that small mammals died from the bite of this saurian.

Soon after there appeared an editorial in the AMERICAN NATURALIST (1882, page 842) referring to the experiments of Dr. Irwin, of the army, which went to prove that the bite of the Heloderm was comparatively harmless; but it added, further, that a specimen in the Zoological Garden of London had bitten a frog and a guinea-pig, both of which had died in a few moments. Still, the editor of the NATURALIST was of the opinion that "this might happen if this large lizard was not poisonous, and there is room for more careful experiments as to its venomous qualities."

In the same year no less distinguished an authority than Dr. Günther, of the British Museum, comes forward and states that there can be no doubt as to the poisonous nature of the bite of *Heloderma horridum*, and cites numerous cases to support his views; and Dr. Sclater, the secretary of the Zoological Society of London, apparently entertained a similar opinion, as did also the eminent herpetologist, Mr. Boulenger, of the British Museum.

During the same year the present writer, who was at that time connected with the Department of Reptiles at the United States National Museum, was severely bitten by an infuriated adult specimen of *Heloderma suspectum*, and although much pain and grave symptoms at once supervened, the results passed entirely away in a few days with barely any treatment. I published a short account of it at the time. Again,

before the year closed, Sir Joseph Fayrer brought forth some evidence, deduced from experiments, that went to show the poisonous nature of the bite of a Heloderm.

Early in 1883, however, the matter seemed to be definitely settled for good, and all through the results obtained by the very celebrated experiments of those two distinguished physicians of Philadelphia, Dr. S. Weir Mitchell and Dr. Edward T. Reichert. After a most carefully conducted series of experiments with the saliva taken from living Heloderms, these authorities were prepared to say that it possessed properties of an extremely venomous nature, killing pigeons and small mammals a few moments after they had received an injection of it hypodermically.

Five years now elapsed with hardly a printed word appearing anywhere upon the question of the poisonous or non-poisonous qualities of the saliva of one of these *suspected* reptiles. Then there appeared an account of the somewhat remarkable series of experiments made with the saliva of living Heloderms by Dr. H. C. Yarrow at the United States Natural Museum, Dr. Yarrow at the time being honorary curator of the Department of Reptiles in that institution. This investigator's methods of procedure were rather different from those adopted by Mitchell and Reichert, but apparently they were conducted with equal care, and, strange to say, led to an entirely different result. Some eight or nine experiments upon chickens and rabbits went to prove that hypodermic injections of the saliva and bites of angry Heloderms were by no means fatal to those animals, and practically they always recovered from the effects of the same. After presenting the steps of his final trial, this author concludes his account with the following remarks: "This experiment would seem to show that a large amount of the Heloderm saliva can be inserted into the tissues without producing any harm, and it is still a mystery to the writer how Dr. Mitchell and Dr. Reichert obtained entirely different results. Were it not for the well-known accuracy and carefulness of Dr. Mitchell, it might be supposed possibly that the hypodermic syringe used in his experiments contained a certain amount of Crotalus obrorca venom, but under the circumstances, such a hypothesis is entirely untenable." The following year Dr. Mitchell still adhered to his original opinion, and undoubtedly does at the present time.

Mr. Samuel Garman, of the Museum of Comparative Zoology of Harvard University, next made some very interesting experiments, by allowing large and vigorous Heloderms to bite the shaved legs of

kittens, and here again these feline victims refused to succumb to the effects of the wounds.

Very evidently the last word upon this subject has not yet been said, and opinions are very much divided,—a host of supporters appearing upon either side. I have endeavored to give in this paper the bulk of the most reliable evidence now out and up to date; but there will undoubtedly be series of interesting experiments made with the saliva of this saurian in the future, and it is very important that there should be. To such experimenters I have a few suggestions to offer here,—the same which should be borne in mind at the time of their investigations, or even in the examination of a person bitten by a Heloderm.

In the case of the latter, ascertain if possible the exact condition of the patient at the time of the infliction of the wound, as regards both sobriety and his general condition. Make sure that the reptile that inflicted the bite was a specimen of a Heloderm. Be careful not to destroy the victim with the remedies you administer to offset the effects of the bite. A quart of raw whiskey, practically given at one dose, may prove more fatal than the bite of ten Heloderms. If the patient die after the bite of one of these reptiles, be sure to ascertain whether it was from the effects of the bite or from the effects of the remedies administered. The locality of the bite and other matters, of course, should also be carefully noted. (R. W. SHUFELDT in *New York Medical Journal,* May 3d, 1891.

T heCervical Vertebræ of the Monotremata.—In the January number of this journal, 1892, I have stated that the zygapophyses are absent in the cervicals of the Monotremata. I have been looking over a paper lately by C. Hasse and W. Schwarck, Studien zum vergleichenden Anatomie der Wirbelsäule, published in Vol. I, of Dr. C. Hasse's Anatomische Studien, Leipzig 1873; I find that these authors have also described the absence of the zygapophyses in *Ornithorhynchus* and *Tachyglossus* (*Echidna*).—G. BAUR.

The Introduction of Reindeer into Alaska.—A very interesting experiment in the introduction of reindeer into this country has been commenced. Dr. Sheldon Jackson, the government agent of education in Alaska, has begun the work. During the past season he imported sixteen reindeer from Siberia, which cost about $160.00. Next year he proposes to establish a herd of reindeer in the neighborhood of Fort Clarence and expects to begin with 100 animals. Siberia has vast numbers of these animals, and in its climate and

vegetation resembles greatly Alaska, so that there is no reason to doubt that they will thrive on the eastern side of Bering Strait. The reindeer is useful as a draught animal for sleds, as well as for its milk, its meat, its skin. From the economical point of view the experiment is of the highest degree of interest, and it is gratifying to see that the Federal Government recognizes the importance of the work.

Capt. M. A. Healey, of the revenue cutter Bear, has reported to the Treasury Department, emphasizing the proposition as the most important question now before the Territory of Alaska. The recent destruction of seals and sea lions has certainly had its effect upon the food supply question of the country and islands in the neighborhood of Bering Strait, and any distress brought about by the destruction of seals may be alleviated by the introduction of the reindeer. In Iceland, where the reindeer was first introduced in 1870, it has increased greatly in number but is said to have relapsed into wildness and is now of little use to the inhabitants. It is to be hoped that better fortune will attend their introduction in Alaska, and that they will be treated as domestic animals, and not share the fate of the buffalo. (*Scientific American*, Oct. 31, 1891).

Nomenclature of Mammalian Molar Cusps.—In October 1888 I sent to the NATURALIST a table of nomenclature for the cusps of the molar teeth of Mammalia based upon the rise of these cusps from the single cone of the reptilian tooth as observed by Prof. Cope and myself. These terms have since been adopted by Cope, Scott, Lydekker, Flower, Schlosser and in part by Rütimeyer. They have not, so far as I know, been adopted by any of the palæontologists of France. Fleischmann, of Erlangen, has opposed their adoption upon the ground that Cope and myself have mistaken the homologies of these cusps in the upper and lower teeth; I have been carefully over this paper and find that every point raised by Fleischmann is erroneous. This author and Döderlein have adopted Greek symbols for the cusps.

Subsequently I have proposed to extend the nomenclature to the crests of the upper and lower molars in the Ungulata.[1] In this paper, as Lydekker has very courteously pointed out, I unfortunately confused "crochet" and "anticrochet" of Busk, and did not rightly interpret Huxley's "pillars." The latest contribution to terminology is Prof. Scott's, which is based upon the law that where the premolars

[1]Bull. Mus. Comp. Zool., Vol. XX, No. 3, Nov. 1890, p. 88.

assume the molar form the corresponding cusps *are not homologous*; this law had already been observed by Schlosser and myself (in *Hyracotherium*), and has now been worked out in many groups by Scott who will shortly publish an abstract of his results.

The principles upon which the new terminology is based are very simple:

1. The termination *-cone* is given to the central primary cusps, and *-conule* to the "intermediate" cusps.
2. The termination *-style* is proposed for the peripheral cusps arising from the cingulum—the Greek form of Huxley's term pillar; these pillars are given the same prefix as the nearest cone.
3. The termination *-loph* is given to the crests.
4. The prefixes are based upon the succession and position of the elements in the primitive evolution of the crown—viz: *proto-*, *para-*, *meta-*, *hypo-*, *ento-*, *ecto-*, *meso-*.
5. In describing the molars of the more primitive types we have to use repeatedly the term "primitive triangle" composed of the paracone, metacone and protocone—for this I propose to substitute the term *trigon* to distinguish the higher and more primitive part of the crown from the lower and secondary *talon*.
6. Corresponding or homologous elements in the upper and lower jaws are given similar terms but distinguished by the arbitrary addition of *-id*.

NEW TERMS PROPOSED.

Upper Molars.	*Lower Molars.*		
Trigon	Trigonid	= Primitive Triangle	Proto-Para and Metacones.
Talon	Talonid	= Heel	Hypoconid, Entoconid, Hypoconulid.
Parastyle = Antero-External buttress			
Mesostyle Median External buttress			
Metastyle = Postero External buttress	Metastylid	= (Reduplication of Metaconid in *Equidae* and other forms).	
Hypostyle = Postero median buttress (developed only in *Equidae*)			
Ectoloph = External crest..			
Protoloph = Anterior crest..			
Metaloph = Posterior crest..	Metalophid	= Anterior crest......	
	Hypolophid	= Posterior crest......	
	Hypoconulid	= Posterior intermediate cusp (3d lobe of last lower molar).	

HENRY F. OSBORN,
American Museum of Natural History,
Central Park, New York.

April 25th, 1892.

EMBRYOLOGY.[1]

Morphology of the Vertebrate Urino-genital System.— From a detailed study of the excretory and reproductive organs of *Ichthyophis glutinosus*, one of the Cæcilians, Professor Semon, of Jena, is led to a conception of the vertebrate urino-genital system containing many points of interest and importance.

The material used consisted of embryos, larvæ and adults obtained in Ceylon by P. and F. Sarasin, and is fully described in the first sixty pages of text with the aid of fourteen plates.

Passing on to the comparative discussion of the results obtained, illustrated by diagrams, we may first give the chief facts observed by the author and then some of his applications of these to the morphology of the excretory and reproductive organs in the entire vertebrate groups.

The pronephros consists of at least twelve pairs of tubes, one pair in each segment, opening into two pronephric ducts that run to the cloaca and opening at the other end by funnels into the body cavity. The dorsal part of the body cavity receiving these twelve pairs of funnels is constricted off as a tube on each side, remaining, however, still in communication with the large ventral part of the coelom by slender tubes that become secondary funnels. These tubes next appear as branches of the original pronephric tubules, each of which now has two funnels, a ventral and a dorsal one. The dorsal tube of coelom is then partly divided by ingrowths of vascular loops, glomeruli, into chambers, one for each dorsal funnel. These chambers are the Malpighian bodies of the pronephros. Irregularities appear in the branching and connections of the pronephric tubules both anteriorly and posteriorly in this long series; finally secondary changes occur and the organ loses its function. Before this takes place the mesonephros appears and both function at the same time. Though chiefly posterior to the pronephros the mesonephros also extends forward so that both organs occur in the same segment. Then it is seen that the mesonephros is dorsal to the pronephros. At the very first the mesonophric tubules are strictly segmental, but very soon the secondary, tertiary, etc., tubules destroy the metameric arrangement. Each tubule has a funnel opening into the large coelom and also opens by what may be regarded as a second funnel into the Malpighian capsule. These meso-

[1]This department is edited by Dr. E. A. Andrews, Johns Hopkins University.

nephric Malpighian capsules may be regarded as parts of the coelom pinched off segmentally, much as those of the pronephros were. The coelom has thus given rise to two series of dorsal diverticulæ, Malpighian capsules, which remain connected with the ventral coelom by tubes with funnels, while their openings into the other nephric tubules are regarded as another primary set of funnels.

The pronephric duct serves also for the mesonephros and the two organs are also connected in another way: each segmental Malpighian capsule of the mesonephros is connected with a longitudinal cord of epithelial cells by means of a similar but more simple transverse cord. This longitudinal cord, on each side of the body, runs back to the cloacal region and is continuous anteriorly with the series of pronephric Malpighian capsules; in fact as the latter degenerate they become incorporated with the anterior end of this cord. The cord is thus a sort of degenerated remnant of a longitudinal coelom tube connected with the pronephric tubules and by solid cords with the mesonephric Malpighian capsules. This degenerate structure is that part of the adrenal body distinguished as the interrenal body of each side.

The Müllerian duct arises dorsal to the nephros and without any connection with the pronephric duct.

The free ventral part of the germinal fold becomes the fat body, some of the dorsal part the germinal epithelium. This germinal epithelium is ventral to the nephros and connected by a loose meshwork of epithelial cords with those similar cords connecting the primary mesonephric Malpighian capsules with the interrenal body. This network disappears in the female but remains, in part, in the male as the tubules conveying the sperm to the kidney. The reproductive gland is not segmentally divided nor are the anastomosing cords going to the kidney.

In applying these facts to the understanding of the urino-genital organs of vertebrates past and present the author regards *Ichthyophis* as presenting many ancestral traits.

Thus the primitive urino-genital system of the Craniata consisted of pronephros and germinal ridges extending from the region of the heart to the cloaca. The germinal cells discharged into the unsegmented dorsal part of the coelom were taken up by the segmental funnels of the pronephros. Later this dorsal coelomic space became pinched off, except for the connecting external funnels of the pronephros, and by ingrowth of glomeruli was converted into a series of Malpighian capsules. Still the reproductive cells pass into these capsules by tubes that elongate as the capsules become more deeply retro-peritoneal.

Finally, in the stage to which all Craniata attain at the present day, a second generation of tubules, the mesonephric tubules, is cut off from the primary pronephric tubules, while the Malpighian capsules divide into dorsal and ventral parts. Into the first open the new mesonephric, into the ventral the primary pronephric tubules, each by its internal funnel, while its external funnel opens into the general coelom. The appearance of this dorsal mesonephros is accompanied by a reduction and transformation of the pronephros, combined with sympathetic ganglia (suprarenal bodies) to form the adrenal body. The reproductive cells must now pass out by the new mesonephric tubules to the pronephric duct.

In male vertebrates there is in addition a reduction of the germinal epithelium to a short portion of its primitive length and a corresponding restriction of the connection of testis and nephros. This leads to the distinction between "sexual" nephros and the more posterior "pelvic" nephros, which is finally quite separated in the higher forms as the *metanephros* or true kidney.

The complete separation of testis and excretory organs in the teleosts and cyclostomes is to be regarded as secondary.

In the female, secondary changes, perhaps connected with increase in size of the ova, have led to the restriction of the egg-conducting function of the pronephros to a single tubule, which then opened into a secondary duct, the Müllerian duct, divided off from the pronephric duct. For the understanding of the true value of the peritoneal opening of the Müllerian duct and for any satisfactory homologizing of the oviducts of teleosts we must await further researches upon these organs in the ganoids.

True abdominal pores, serving for exit of the reproductive products in Cyclostomes but not in any Gnathostomes, are to be regarded as having probably taken that function secondarily. Their morphological value remains unknown: functionally they may perhaps be brought into relation with the need of communication of the coelom and external water to equalize pressure in deep sea forms.

In many vertebrates the original function of the external nephric funnels, those opening into the large coelom as contrasted with the internal funnels opening into the Malpighian capsules, that is the passing out of water from the coelom, has been assumed more and more by the glomeruli and thus the external funnels have been abandoned as useless. Along with this loss of the coelom funnels there has been a loss of cilia in the tubules, in many forms, since

there was no longer need of other than the vascular pressure in the closed system of tubules and Malpighian capsules.

The venous system has undergone important changes in connection with the nephric organs. Thus the primitive net-work of veins passing from the pronephros to the heart becomes reduced to the two posterior cardinal veins as the pronephros degenerated, though remaining as segmentally arranged veins in the mesonephric region. Later the two fused posterior cardinal veins form with the remnants of the primitive sub-intestinal veins the median post cava.

In attempting a comparison of the vertebrate and any non-vertebrate we must consider Amphioxus as in many ways a primitive form. Thus in its urino-genital system the possession of nephric tubules throughout the branchial region is to be interpreted as a retention of the pronephros in a more anterior region than that it is now retained in amongst the Craniata; while the discharge of reproductive products has been changed from its primitive course through these tubules. If Boveri succeeds, as the author seems to think he will, in homologizing the peribranchial space of Amphioxus with the pronephric ducts, which are regarded as having an ectodermal connection, the unity of the nephric system in the Chordata would be demonstrated. At the same time the resemblance to the Annelid organs becomes very striking, yet as there can be no question of derivation of Chordata from real Annelids the author asks if this resemblance may not be a case of convergence.

On the same line that E. Meyer has imagined the Annelid's metamerization to have come from the segmentation of the reproductive tubes, Semon, while waiting for more light upon the value of the coelom, wonders if in the Chordata reproductive tubes may not have given rise to the mesoblastic somites, parts of which are still separated off as the Malpighian capsules with the old nephric tubules leading to the exterior, though now brought into use as parts of the excretory rather than reproductive passages.

Hermaphroditism the author thinks was not a primitive trait of the Chordata, but where occurring, as in other groups, is to be regarded as a remnant or re-occurrence of the original hermaphrodite nature of the reproductive gland in all Metazoa; such organs as the Müllerian duct in the male being transferred from the other sex; the inverse of what has taken place in the case of the mammary glands.

In connection with this work it is of interest to note that Hans Rabl[1] in a study of the adrenal bodies of birds derives the non-nervous

[1]Arch. f. mik. Anat. 38, 1891, p. 28. 3 pls.

part from the degenerating pronephric tubules, thus confirming Semon's view without a knowledge of Semon's full paper.

Formation of the Germ Layers in an Ophiurid.[1]—*Amphiura squamata* (Say) had been incompletely studied in 1870 by Metschnikoff who argued from analogy that there was here an invaginate gastrula though he did actually observe it. In 1882 Apostolides claimed that it was formed by delamination, but he gave no figures. Fewkes in 1887 confirmed this view but did not add much to its substantiation owing to lack of material.

In the present paper Russo considers the formation of the blastula, the entoderm and the mesoderm in this species.

Cleavage gives rise to a very characteristic blastula having elongated cells surrounding a rather small cleavage cavity.

The inner part of each cell is made very opaque by a quantity of pigment which is thought to be related to the presence of food-yolk: the outer part of each cell is yellow and transparent. The blastula thus looks like that of Geryonia.

The inner pigmented part of each cell becomes divided from the outer part and the resulting gastrula has an ectoderm of transparent, elongated cells with large nuclei and an entoderm of smaller, rounded, pigmented cells.

He thus extends the occurrence of delamination to a new group. Following Brouer he attributes this mode of gastrulation to the conditions of development. "Everywhere when a free-swimming blastula is present we find unipolar entoderm formation, corresponding to the direction of swimming: everywhere when development goes on in a limited space we find multipolarity." This the author thinks is true of the Echinoderms as well as of the Coelenterates.

The proctodoeum and the archenteron are formed by the breaking down at a definite point, first of the ectoderm and then of the entoderm. After this the mesoderm appears: first as a heap of irregularly shaped cells on either side of the proctodoeum. These cells arise by delamination from the ectoderm and, pushing backward, nearly fill the whole cleavage cavity. They finally arrange themselves upon the ectoderm and the entoderm, like an epithelium, thus forming a single cavity, the coelom.—G. W. Field.

The Origin of the Sertoli's Cell.—It is now generally known that the seminiferous tubules of a mammalian testis contain two funda-

[1]Achille Russo: Zool. Anz. Nov. 16, 1891.

mentally different kinds of cells; 1. The sperm-producing cells; 2. The sperm-nursing cell. The latter have been called Sertoli's cells by v. Ebner, in honor of the discoverer: they are also known as; spermatoblasts (v. Ebner); copulation cells; supporting cells; *Fusszellen, Stützellen; cellules de sentien*, etc.

The sperm-producing cell is essentially migratory in habit and as soon as it attains a certain stage of growth it leaves the wall of the tubule and undergoes a manifold series of changes within the tubule.

In this respect the young sperm mother-cell offers a striking contrast to the young egg cell, which leads a sedentary life up to the last stage of maturity when it first becomes free by the rupture of the follicle.

The changes which the young spermatogonium undergoes after leaving the basement-membrane of the tubule are quite well understood. On the other hand, the history of the Sertoli's cell is not sufficiently known. The Sertoli's cell has a most characteristic appearance and is very easy to recognize by its comet shaped cytoplasm, by its large vesicular nucleus, and by its characteristic nucleolus. It is not likely that a single set of Sertoli's cells perform the nursing function for the several consecutive crops of spermatozoa. My conclusion, in regard to this point, as based on the study of human spermatogenesis, may be briefly stated as follows:—The sperm-nursing cell (the Sertoli's cell) in the seminiferous tubules of a mammal arises from a distinct anlage of its own, as the spermatozoan arises from the spermatogonium. In short, not only the two kinds of functional cells, —the sperm and its nurse—exist in the seminiferous tubule, but also the distinct antecedent cells for each of them; or more properly, the existence of two different kinds of cells in the functional seminiferous tubule is due to the existence of two entirely different kinds of antecedent cells. Just as the spermatogonia or the "Stammzellen" are the antecedent structure for the spermatozoa, so the small, stellate cells—*cellules étoilées* of Renson—found in the interstitial spaces of the spermatogonia are the antecedents of Sertoli's cells. The stellate cell stains quite differently from the adult Sertoli's cell, as the young spermatogonium stains differently from the adult spermatozoan. I have been able, however, to trace the series from the young stellate cell up to Sertoli's cell almost as completely as between the spermatogonium and the spermatozoan. The youngest spermatogonium stains quite differently from the youngest stellate cell, so that the difference between the two cells, the sperm and its nurse, begins extremely early. If they were derived from the same source, the differentiation in these

two directions must have taken place at the beginning of the embryonic history of the animal. My results therefore lend no support to the views in which Sertoli's cells are regarded as the modification of the sperm-producing cell proper or of its direct derivatives.

The differential staining was accomplished in a satisfactory manner by the use of two new aniline colors, viz: *Cyanine* and *Chromotrop*. *Erythrosine* has yielded also a very satisfactory result. The results of the application of these colors to the study of spermatogenesis and the differential staining of sexual cells after the manner of Auerbach, I shall report at no very distant future.—S. WATASE, Clark University, Worcester, Mass.

ENTOMOLOGY.[1]

A Spider Enemy of Oeneis semidea. — All butterflies seem to have enemies that prey upon them during some if not all stages of their existence, and *Oeneis semidea*, which lives on the top of our highest New England mountain, is no exception to the universal rule.

During a brief visit to Mt. Washington, N. H., during the summer of 1889 I was surprised while collecting on Semidea Plateau, as Mr. Scudder has very appropriately termed a favorite locality for this butterfly near the top of the mountain, to see great numbers of a dark bluish-black spider (*Pardosa albomaculata* Emerton) which seemed to be found everywhere, and was particularly noticeable along the carriage road leading from the lower end of this plateau to the summit. My first thought on seeing these spiders in such numbers was what were they doing at such an altitude, over 5000 feet; surely there were not sufficient flies at such an elevation to feed them, and in fact I saw none whatever; neither did I notice spider webs, and these would seem quite necessary were they feeding on flies. Therefore I took pains to learn, if possible, the reason of their being in that particular area and nowhere else observable on the mountain. I had noticed many dead and imperfect butterflies lying on the ground, especially along the roadway, but not suspecting the real cause, supposed they were killed by the passing of teams or exposure to the fierce cold winds which occasionally sweep across the mountain even in the summer time. It was not, however, until next to the last day of my stay on the summit that I discovered the true explanation for the great mortality among the butterflies and the presence of this peculiar spider.

[1]Edited by Prof. C. M. Weed, Hanover, N. H.

Upon the day in question, with the thermometer at 40° and a cold misty wind blowing from the North, I was coming down the road from the hotel to Semidea Plateau when I caught sight of a butterfly a few yards ahead, on the ground which was being blown sideways by the wind while attempting to walk. What was my surprise to see one of the spiders rush from behind a small stone and leap upon and fasten itself with tiger-like grip upon the chilled and almost helpless butterfly At that instant I realized the significance of the act, and the question was settled in my mind why these spiders were to be found in this inhospitable region. Securing both spider and butterfly for future use and to make sure that this was not an unusual occurrence I shortly afterward made several experiments by placing partially dead butterflies near different spiders to watch their actions, and invariably they rushed upon them in a most ferocious manner. With a thread attached to a butterfly I induced a spider to follow it at least a rod in his mad endeavor to obtain the coveted prize.

It is my opinion, although I have positive knowledge only in regard to the perfect insect, that this spider subsists almost entirely upon *Oeneis semidea* during its various stages. One always sees them searching about among the rocks or sedge, apparently hunting for the egg, larva or perfect insect in hiding, and even when it is so cold and damp that the butterflies are chilled and scarcely move, the spiders do not seem to be affected but act as if it was their golden opportunity to obtain a dinner, and search for it at that time with unusual vigor. As my time and means were limited perhaps it would be well for future collectors who visit this locality to study more closely and carefully this peculiar spider in this bleak and bare region. Perhaps, like the butterfly, this, too, is a remnant of a once widely disseminated species, but which with the receding glaciers found conditions and food favorable for its existence only on the tops of our highest mountains.—SHELLEY W. DENTON, Wellesley, Mass.

Biology of the Chalcididæ.—Mr. L. O. Howard[1] has published an extremely interesting paper upon a subject concerning which he speaks with the authority given by years of careful study. It consists of a general review of our present knowledge concerning the life histories of the interesting hymenopterous parasites of the family Chalcididæ. The scope of the discussion is indicated by the following list of the sub-headings: The insects and stages of insects infested by Chal-

[1]The Biology of the Hymenopterous insects of the family Chalcididæ, by L. O. Howard. Proc. U. S. Nat. Mus., No. 881.

cidids; How the Chalcidid larva lives; How fast does it develop; How the larva transforms; How many develop in a single host; Proportions of sexes in issuing; Phytophagic habit; Parthenogenesis; How large is the family.

Mr. Howard's conclusions concerning the number of species in the family will be a surprise to many entomologists. They indicate how much yet remains to be done in the field of descriptive entomology in America. The author says: "In this country (America, North of Mexico) the latest list (Cresson's, 1887) records only 413 species, while I have recorded (Bull. V, Div. Ent.), in addition to those, 128 species from Mexico and the West Indies. For the purpose of this paper I have gone carefully over the collection of the National Museum and estimate the number of species of this family contained in that one collection at something over 2000, nearly all from America, North of Mexico. According to my best judgment this represents a very small proportion of the species yet to be found within these geographical limits, as almost no effort at general collecting has been made, and these 2000 species are very largely the result of accidental breeding. When a single sweep of the beating net on the Department grounds at Washington will result in the capture of five new species what will be the result when the entire country shall have been collected over by sifting, beating and the many other devices known to experienced collectors? I fully believe that to estimate the number of species of this one family in North America as exceeding the number of described North American species of the entire order Hymenoptera would be far below the truth. When we consider, as shown in a previous section, that these small hymenopterous parasites live upon or within some one or several of the stages of perhaps the majority of insects of all orders, then we no longer wonder at their numbers or at the great variety exhibited among them."

The Gypsy Moth.—A recent issue of the *Salem* (Mass.) *Gazette* contains the following account of the Gypsy Moth developments in that region:

Amidst all the hue and cry against the importation of foreign contract laborers, foreign paupers and foreign fevers it is to be considered to what an extent this country has been victimized through the importation of foreign weeds, birds and bugs. A field of daisies may be an attractive sight from an æsthetic standpoint, but to the farmer it is simply a lot of undesirable white weed, spoiling a crop of good English hay. The little plant which rightfully bears the title of the royal

Plantagenets, and spreads its golden glory all over some of our neighboring hills, is practically a nuisance, and deserves its ignominious name of wood-wax, by which it is commonly known. These and the English sparrow are instances of unwise importation.

But the latest offender, and the prospect seems promising that he may prove the chiefest and worst, is the individual who first brought to this country a specimen of the gypsy moth. If he had taken the precaution to chloroform him—or her—or to impale the insect after the cheerful manner of his brother entomologists, the cause of science might have been enriched without danger to the cause of arboriculture. But the ambition of this collector vaulted above the low level of pin-stuck bugs. He would be the proud possessor of the only real live gypsy moth in America. He was for a time.

Then the moth, imbued with that new spirit of liberty which all other immigrants from monarchial tyranny are said to feel when they reach the home of the brave and the land of the free, just got away. It set up house-keeping on its own account and proceeded to raise a family. How well it succeeded in the latter operation is a matter upon which certain acts of the Legislature of Massachusetts and certain items of expenditure recited in the reports of the Auditor of the Commonwealth may throw some light.

The first instance of the appearance of the *Ocneria dispar*—this is the bug's company name—in the literature of the blue books, is at the head of chapter 95 of the Acts of 1890, wherein the Governor is authorized to launch a brand new commission on a long suffering public to consist of three suitable and discreet persons charged with the duty of preventing the spreading and securing the extermination of the gypsy moth.

The nameless individual who wrought the mischief by importing the progenitor of the race was protected by the constitutional prohibition of *ex post facto* laws from receiving a fit penalty for his dire offence; but it was provided that henceforth it should be unlawful for any person to knowingly bring the insect, or its nest, or its eggs within the Commonwealth, and that a fine of two hundred dollars or durance vile for sixty days should await the culprit convicted of breaking the laws.

Last year the Legislature repealed the act of 1890 but substantially re-enacted its provisions, except that it transferred the responsibility of selecting the suitable and discreet bug-hunters from the Governor to the State Board of Agriculture. Suitable and discreet persons cost something when these qualities are demanded by the Commonwealth.

They have cost so far an even hundred thousand dollars. Let it not be whispered in Gath that an extermination which exterminates would be undesirable for any such reason as that it would also exterminate the salaries. Governor Russell has just signed a new bill for seventy-five thousand dollars more, and forty men will immediately gird them for the fight.

And the end is not yet. Thirty towns and cities, covering an area of two hundred miles, have the prolific progeny of the unwelcome visitor already infested. Official circulars posted behind the Salem postoffice door impart the unwelcome intelligence that they are here. If the ninety and nine moths are killed and the one that escapes becomes the happy parent of a quarter of a million or so of little gypsies, and this ratio of destruction and increase is maintained ad infinitum, where will the suitable and discreet men eventually be, and what will be left of the State Treasury but an empty chrysalis?

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

U. S. National Academy of Sciences.—This body met in Washington on April 18–21st for the transaction of business and the reading of papers.

The following papers were read:

The American Maar, G. K. Gilbert; The Form and Efficiency of the Iced Bar Base Apparatus of the U. S. Coast and Geodetic Survey, R. S. Woodward (Introduced by T. C. Mendenhall); On Atmospheric Radiation of Heat in Meteorology, C. Abbe; On the Deflecting Forces that Produce the Diurnal Variation of the Normal Terrestrial Magnetic Field, F. H. Bigelow (Introduced by C. Abbe); Abstract of Results from the U. S. Coast and Geodetic Survey Magnetic Observatory at Los Angeles, Cal., 1882–1889, part III.; Differential Measures of the Horizontal Component of the Magnetic Force, C. A. Schott; On the Anatomy and Systematic Position of the Mecoptera, A. S. Packard; On the Laws of the Variation of Latitude, S. C. Chandler; On the Causes of Variations of Period in the Variable Stars, S. C. Chandler; On the Force of Gravity at Washington, T. C. Mendenhall; On the Recent Variations of Latitude at Washington, T. C. Mendenhall; On the Acoustic Properties of Aluminum, with Experimental Illustrations, A. M. Mayer; Description of the Silver Haloid Molecule by Mechanical Force, M. Carey Lea (Introduced by G. F. Barker); On the Homologies of the Cranial Arches of the Reptilia,

E. D. Cope; On the Osteology of the Genus Anniella, E. D. Cope; The Astronomical, Geodetic, and Electric Consequences of Tidal Strains within an Elastic Terrestrial Spheroid, by C. Abbe; Asiatic Influences in Europe, by E. S. Morse; Exhibition of Chladni's Acoustic Figures Transferred to Paper without Distortion, by A. M. Mayer, and on Electrical Discharges Through Poor Vacua and on Coronoidal Discharges, by M. I. Pupin.

The following gentlemen were elected members: Carl Barns, physicist, of Washington; M. Carey Lea, of Boston, chemist; and S. F. Emmons, of Washington, geologist; no biologist was elected.

Academy of Natural Sciences, Philadelphia.—On Feb. 19th the new lecture hall of the Academy was opened. Dr. Harrison Allen lectured on the "Mechanism of the Mammalian Limb," which was richly illustrated with natural history specimens. Rev. Dr. McCook, in the absence of the president, General Wistar, made the address of the evening, on the opening of the new hall.

Among other things Dr. McCook said: "This building marks the culmination of a new life and policy which a few years ago was adopted by the Academy's administration. Professorships had been provided for in our constitution, but they were only high sounding titles. There were no men to occupy them. It was resolved that, first of all, the professorships should be filled, and that next, work should be given professors to do.

"Only a few years ago a few enthusiastic young professors were placed in the van of the new endeavor. Among them the late Carvill Lewis, Prof. Benjamin Sharpe and Prof. Angelo Heilprin. Prof. Brinton came in at a later date and Prof. J. Gibbons Hunt, the nestor of the faculty, contributed something by his admirable popular lectures before the section of biology and microscopy. The new departure was a substantial success.

"Long before the University Extension movement presented itself the Academy was working on the same lines. And the culmination of this work is this new hall which is now open for classes and courses of lectures.

"This, however, is but the vestibule of an unfinished building. The citizens of Philadelphia should hasten to the completion of the museum building of which this hall forms a part. Complete this building; give us money to endow richly the museum; set these eager hands and minds with all this machinery to work their best, and in twenty-

five years or less there will be no institution to which you may point with such proud satisfaction as this Academy of Natural Sciences."

Boston Society of Natural History.—April 20.—The following papers were read: Dr. John Murray, Some Recent Investigations into the Physical and Biological Conditions of the Lochs and Fjords of the West of Scotland; Mr. E. Adams Hartwell, An Elevated Pothole at Fitchburg, Mass; Mr. George H. Barton, Additional Notes on the Drumlins of Massachusetts.—SAMUEL HENSHAW, *Secretary pro tempore.*

The Biological Society of Washington.—April 16.—The following communications were read: Dr. C. W. Stiles, Notes on Parasites, *Tænia ovilla* in its relation to Blanchard's Classification; Mr. F. V. Coville, The Flora of the High Sierras of California; New Plants from California, Nevada, and Utah; Dr. Erwin F. Smith, A Review of Baillon's Botanical Dictionary; Mr. J. N. Rose, Mexican Leguminosæ with Notes on Dr. Palmer's collection.

April 30.—The principle paper of the evening was The Distribution of Land, Water and Ice on this Continent in Later Geological Periods, by Prof. W. J. McGee. Other communications were: Dr. Erwin F. Smith, The Relation of Plants to the Soil. (Illustrated); Mr. Charles Hallock, Where Salt-water Fishes Hide; Results of Deep-water Seining.—FREDERIC A. LUCAS, *Secretary.*

Proceedings of the Natural Science Association of Staten Island.—April 9.—Meeting called to order at 8.30 o'clock. In the absence of the president, Mr. Arthur Hollick was elected chairman *pro tem.*

Mr. L. P. Gratacap submitted the following additional facts in regard to the fossil leaf exhibited at the last meeting.

The specimen was found at Richmond valley, (not at Richmond as previously reported,) a few rods north-east of the railroad station, in an excavation made for a cellar. It was originally part of a larger slab, about 1½ feet square, which seemed to be imbedded in the Drift of the hillside. No indication of any stratum or layer of material similar to the rock was noted. It was found about four years ago, by Mr. Mesner, from whom the above facts were obtained.

Mr. Hollick remarked that the locality, as corrected, removed one of the elements of improbability, which had caused the specimen to be looked at with suspicion, and that it had now been brought within

the area where such a leaf might be looked for. The specimen apparently belongs to the Cretaceous genus *Grewiopsis*, and is contained in a sandstone similar to that of the Dakota group. How it came to be in the position where it was found is more or less problematic, but similar sandstone is found associated with the Cretaceous clays, and it may have been originally in one of these layers, which subsequently suffered erosion and transportation by glacial action, as we know to have been the case with other Cretaceous material in the neighborhood. If such specimens are ever found in place the probabilities are that they will be located in the sandstone layers overlying the Cretaceous clays to the north and west of Richmond Valley station.

Mr. Joseph C. Thompson exhibited a skin of a large muskrat, which was killed in the basement of his residence, at Clifton, on the morning of April 1st.

Mr. Hollick showed a diorite pebble, with a thin section of the same for microscopic examination. The specimen was found in the Drift at Princes Bay and attracted attention from its coarse porphyritic structure, so different from that of the close-grained diabase common in the vicinity. The thin section submitted to microscopic examination showed it to be a diorite, consisting of hornblende and plagioclase feldspar, the former partly altered to green actinolite. A similar rock was found in a place by Mr. Gratacap, on Lambert's Lane, Northfield, and was described by him in the Proceedings for December 12th, 1891.

Mr. Hollick referred to the memorandum in regard to a nest of the Barred Owl having been found near Bull's Head, as noted in the Proceedings of April 11th, 1891, and stated that the birds had again nested in the same tree. On March 12th of the present year a set of three eggs were found by Mr. Charles R. Harte. The tree is located in the same patch of woodland in which the Red Shouldered Hawk nests every year.

SCIENTIFIC NEWS.

Mr. Timothy Hopkins has made provision for the endowment and maintenance of the seaside laboratory at Pacific Grove recently established under the auspices of the Leland Stanford Junior University, mention of which was made in the last number of this journal. It is intended to make this a place for original investigation of the habits, life history, structure and development of marine animals and plants and to carry on work here similar to that which has made the aquarium at Naples known all over the world.

The Hopkins Laboratory will be under the general direction of Profs. Gilbert, Jenkins and Campbell. It will be open during the summer vacation and its facilities will be at the disposal of persons wishing to carry on original investigations in biology as well as of students and teachers interested in that line of subjects. It will be fully provided with aquaria while microscopes, microtomes and other instruments necessary for investigations will be taken from the laboratories of the University.

The Botanical Club of San Francisco has 155 members. It holds meetings on the first and third Mondays of each month in the lecture hall of the California Academy of Sciences. The officers for the present year are: President, Dr. Douglass H. Campbell; Vice President, Mrs. S. W. Dennis; Secretary, Frank H. Voslet; Treasurer, Miss A. M. Manning; Librarian, Mrs. S. W. Burtchaell; Curator, Miss E. B. Falkenan; Councillors, Mrs. L. D. Emerson, C. C. Riedy, and Miss C. H. Hittell.

The announcement is made that Grevillea, the well-known journal of cryptogamic botany, will cease publication with the close of the twentieth volume, unless other hands than those of its present editor, Mr. M. C. Cooke, take it up and carry it on.

F. B. Caulfield, an entomologist of Montreal, died in that city March 15, 1892.

Dr. Unna offers yearly a prize of Mark 300 for dermatological essays. This year the subject is "Schwund und Regeneration des elastischen Gewebes der Haut unter verschiedenen pathologischen

Verhältnissen." The essay must reach the publication office of Leopold Voss in Hamburg by the beginning of December, 1892. The judges this year are Profs. Klebs and Hoyer.

Mr. Godefroy Lunel died in Geneva, Nov. 17, 1891. His place as director of the Natural History Museum there has been filled by the nomination of Dr. Maurice Bedot.

The Natural History Society of Buda-Pesth, Austria, is said to have a membership rising to 7800.

Prof. H. S. Williams of Cornell, has been elected professor of geology at Yale University, to take the place of the Veteran James D. Dana. Prof. Dana still retains his connection with the University and will do some lecturing, but advancing years do not allow him to devote himself as before to class work.

Mr. W. M. Goldthwaite of New York City has started a new magazine entitled "Minerals" the scope of which is indicated by the name.

A Correction.—The article entitled "Abnormal Duplication of the Urosonic in Rana catesbiana" in this journal for August 1891, should have been credited to Wm. L. Sherwood, 199 West 134th St., New York City.

The Rev. C. J. Ball, M.A., continues to advance arguments in support of the identity of the ancient Accadian ideograms with early Chinese signs, in a series of interesting papers read before the Society of Biblical Archeology, and printed in the Proceedings of the Society. The Accaians were the original inhabitants of Assyria and Babylonia prior to thed incursion of the Semitic race. By some writers they are credited with the invention of that cuneiform or arrow-headed and wedge-shaped script, from which M. De Lacouperie maintains the early Chinese characters were derived, being cuneiform merely transferred from left to top, sometimes from an upright to a horizontal position.

Mr. Stewart Culin, of Philadelphia, the author of some able papers on "The Secret Societies of the Chinese in America," and "Chinese Games with Dice," has just issued another agreeably written memoir, "On the Gambling Games of the Chinese in America." It appears in the fourth number of the first volume of the Series in Philology, Literature, and Archeology of the publications of the University Press

of Pennsylvania,—a very promising series of well-printed little monographs on various subjects, issued at a most reasonable price. The game of fan t'an, or "that of repeatedly spreading out," is played in a cellar or basement, a sentinel being stationed without the door to give notice of the approach of danger. A second, of which the name Pak kop piu signifies "the game of the white pigeon ticket," is played in attics, pigeons being formerly employed to convey the tickets and winning numbers from the offices to their patrons. This is really a kind of lottery, and the assistants who prepare the papers are dignified with the title of Sin' shang, literally "first born" the equivalent to "Mr.," and the only title of respect used among the Chinese laborers in America. Gamblers of this nationality, like all others, are very superstitious, avoid the use of certain colors, and eat in silence the suppers provided by the gambling companies. They propitiate the gods with liberal offerings, and sometimes erect shrines in recognition of a successful *coup*. Their love of games of chance, in Mr. Culin's opinion, tends to give permanency to the Chinese settlements in America, as they cluster round the gambling places in the large cities.